JPRS 79268

22 October 1981

East Europe Report

ECONOMIC AND INDUSTRIAL AFFAIRS

No. 2191

Development of Power Engineering,
Joint Power Systems of CEMA Countries Surveyed

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 79268

22 October 1981

EAST EUROPE REPORT

ECONOMIC AND INDUSTRIAL AFFAIRS

No. 2191

DEVELOPMENT OF POWER ENGINEERING, JOINT POWER SYSTEMS OF CEMA COUNTRIES SURVEYED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 5-72

[Translation of an issue of the journal devoted to the 25th anniversary of the Permanent CEMA Commission for Cooperation in the Power Engineering Area]

CONTENTS

Permanent CEMA Commission on Cooperation in Power Engineering Activities - P. Neporozhniy . . . 1
Development of Power Engineering in Bulgaria Traced - N. Todoriev . . . 17
Present State, Prospects of Hungarian Power Development - L. Kapoly . . . 26
Cuban Power Construction Plans Traced - Jose Beltran . . . 34
Rapid Development of Mongolian Fuels and Power Industry Viewed - S. Batkhuyag . 38
Role of Polish Thermal Power Capacity Described - Z. Bartosiewicz . . . 45
Development of Power Sources in Romanian Industrial Plans - T. Cocirla . . . 52
Development of CSSR Power Industry Described - J. Goldschmidt . . . 60
Role of Central Dispatching Administration Reviewed - R. Grinyuk . . . 68
Development of CEMA United Power Systems Described - G. Ilarionov . . . 77
Activities of Section on Thermal Power Development Viewed - S. Kus . . . 84
Achievements in Hydropower Development Reviewed - G. Luka . . . 88
CEMA Research Projects in Power Area Described - J. Fisher . . . 96
CEMA Cooperation in Nuclear Power Engineering Outlined - F. Ovchinnikov . . . 104
Development of Power Engineering Information System Viewed - M. Yaganov . . . 111

FREQUENTLY-USED ABBREVIATIONS

CEMA PCCPEA - Permanent Commission for Cooperation in the Power Engineering Area
TETs - Thermal Power Plant
VETs - Hydropower Plant
AETs - Nuclear Power Plant
PAVETs - Pumping-Storage Hydropower Plant
UPS - United Power System
JPS - Joint Power System
CDA - Central Dispatching Administration

PTL - Power Transmission Line
LSCP - Long-Range Special Cooperation Program
MOSNTI - International Sectorial System of Scientific and Technical Information

PERMANENT CEMA COMMISSION ON COOPERATION IN POWER ENGINEERING ACTIVITIES

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 5-13

[Article by Petr Neporozhniy, USSR Minister of Power and Electrification and Chairman of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "Twenty-Five Years of the Permanent CEMA Commission for Cooperation in the Power Engineering Area"]

[Text] At the present stage of economic development the most important intersectorial problem is the fuel and energy one and a solution to it depends largely upon the capabilities, rates and directions of economic and social progress. From this viewpoint the cooperation of the socialist nations within CEMA is of enormous significance. The pooling of efforts by the concerned nations, in being directly linked to the development of integration processes in their economy, has played a substantial role in settling the problems of meeting the increasing needs of the CEMA country national economies for energy and fuel.

The fuel and energy system is the most complex and dynamically developing sphere in the present-day economy of the CEMA countries.

The Long-Term Special Cooperation Program (LSCP) of the CEMA Countries in the Area of Energy, Fuel and Raw Materials adopted at the 32d CEMA Session (1978) is aimed at assisting the meeting of their rational demand for various types of energy resources.

At present more than 30 percent of the energy resources produced in the world are employed for power generation. Power engineering has been marked by significant progress. This has been caused by the universal nature and great efficiency from the use of electric power in comparison with other types of energy.

V. I. Lenin placed the victory of the socialist system directly dependent upon the development of electrification in the national economy as the technical base of social production.

At present the mechanization and automation of production processes are inconceivable without electrification. The specific consumption of electric power has become one of the basic indicators for the industrial development level of any nation. Electric power is being introduced widely into the sphere of municipal and household services for the public and raises the standard of living of the workers. The level of the energy- and electricity-to-labor ratio and their dynamics largely determine the level and trends in the change of social productivity.

The CEMA countries are giving ever-greater attention to meeting the growing needs for electric power. A constant rise in the electricity-to-labor ratio and a constant increase in the per capita consumption of power resources, and particularly electric power, are the ways for economic development in the CEMA countries. These have led to a significant increase in the share of the CEMA countries in world electric production. From 13.6 percent in 1950 this has risen to 21.8 percent in 1979.

The successes in the development of power engineering in the CEMA countries have been largely aided by the multilateral cooperation carried out under the Permanent CEMA Commission for Power Engineering [CEMA PCCPEA] which was set up in 1956 as a permanently operating sectorial commission.

At present participating in the commission's work are Bulgaria, Hungary, Vietnam, the GDR, the Republic of Cuba, Mongolia, Romania, the USSR and CSSR. According to an agreement between CEMA and the Yugoslav government, since 1967 a Yugoslav delegation has participated in the commission's work on questions of mutual interest.

The basic tasks of the CEMA PCCPEA are a further deepening of multilateral economic and scientific-technical cooperation among the CEMA countries to ensure the planned development of their power engineering, to accelerate technical progress in this area and further develop socialist economic integration.

The primary attention shown by the countries to the question of multilateral cooperation in the area of power engineering is determined by the following basic prerequisites:

1) The necessity of maintaining sufficiently high growth rates for the consumption of electric power with a constant equilibrium between the process of its consumption and production;

2) The uneven distribution of the natural fuel and energy resources over the territory of the CEMA countries;

3) The technical and economic advantages of the parallel operation of the United Power Systems [UPS] of the CEMA countries.

The most important areas in cooperation among the CEMA countries within the commission are the coordinating of the national economic plans for the development of the sectors and basic scientific and technical research in power engineering, the questions of the parallel operation of energy systems and the exchange of experience in the designing, construction and operation of power projects.

The TETs in Ulan Bator, Mongolia, built with CEMA cooperation

The organizing of the parallel operation of the UPS in the CEMA European countries is one of the basic directions in the development of the international socialist division of labor in power engineering.

At the time the CEMA PCCPEA was founded, in many nations such as Bulgaria, Hungary, Poland and Romania, the power systems were in the formative stage. Electric power was produced from small plants which provided electricity for individual, isolated areas. The highest voltage in the power networks was 220 kilovolts (the GDR, Poland, the USSR and CSSR) and 110 kilovolts (Bulgaria, Hungary and Romania).

The annual per capita power consumption in 1955 in Bulgaria was 281 kilowatt hours, 576 in Hungary, 652 in Poland, 249 in Romania, 1,137 in the CSSR and 1,559 in the GDR. In the developed capitalist countries this indicator was, respectively: 1,150 kilowatt hours per year in France, 1,470 in the FRG and 1,750 in England.

To ensure the rapid development rate of power engineering and reliable power supply, in 1956 the commission received studies containing specific recommendations on unifying the power systems of the CEMA countries by building intersystem power transmission lines [PTL], constructing large power plants operating on local fuels in certain nations and increasing the exchange of electric power between the CEMA nations.

The recommendations for the initial stage of carrying out the parallel operation of the UPS, including the proposals to build intersystem PTL were worked out by the commission on the basis of proposals of the involved countries and approved by the 11th CEMA Session in 1959.

Virtually all the recommendations were carried out within the shortest period of time.

In 1960, the first intersystem lines were built with a voltage of 220 kilovolts between the GDR and Poland, the GDR and the CSSR and Poland and the CSSR with a double-circuit system and between the CSSR and Hungary with a single-circuit one.

A start was made to parallel operation between these countries. In 1962, over a 220-kilovolt doublt-circuit line the L'vov power system of the USSR was linked up with them, in 1963, the Romanian power system and in 1967, after the linking up of the Romanian-Bulgarian 220-kilovolt power line, unification was basically completed for the power systems of all the European CEMA countries.

In organizing parallel operation an important role was played by the completion in 1965 of the Mukachevo international junction substation built on the basis of a multilateral agreement.

For the fuller utilization of the technical and economic advantages of paralleling the UPS and for coordinating the actions of the national state dispatching administrations, upon the initiative and with the direct participation of the commission, in 1962 an international organization was set up, the Central Dispatching Administration (CDA) of the United Power Systems with headquarters in Prague. The agreement to form the CDU was signed by the governments of Bulgaria, Hungary, the GDR, Poland, Romania, the USSR and CSSR.

As early as 1963, the effectiveness of unification was clearly apparent. With the presence of an acute electric power shortage arising out of unforeseen factors in certain of the nations, the neighboring power systems of the CDA member nations provided fraternal aid.

The creation of the UPS contributed to a rapid rise in the power engineering of the CEMA member nations. In just 10 years from the founding of the CDA, the total installed capacity of the UPS paralleled power plants has risen from 25,400 megawatts to 62,100. Power production in the UPS has risen correspondingly.

The activities of the CEMA PCCPEA in the following stage were devoted to the questions of collaboration among the nations in further improving and raising the reliability of parallel operations in the UPS and the long-range development of power engineering. The further development of the UPS was accompanied by the intensive development of 220- and 400-kilovolt intra- and intersystem power lines, by the growth of power production and the exchange of electric power, by an increase in the capacity of the paralleled plants and the unit capacity as well as by an improvement in the technical and economic indicators for the production and transmission of electric power.

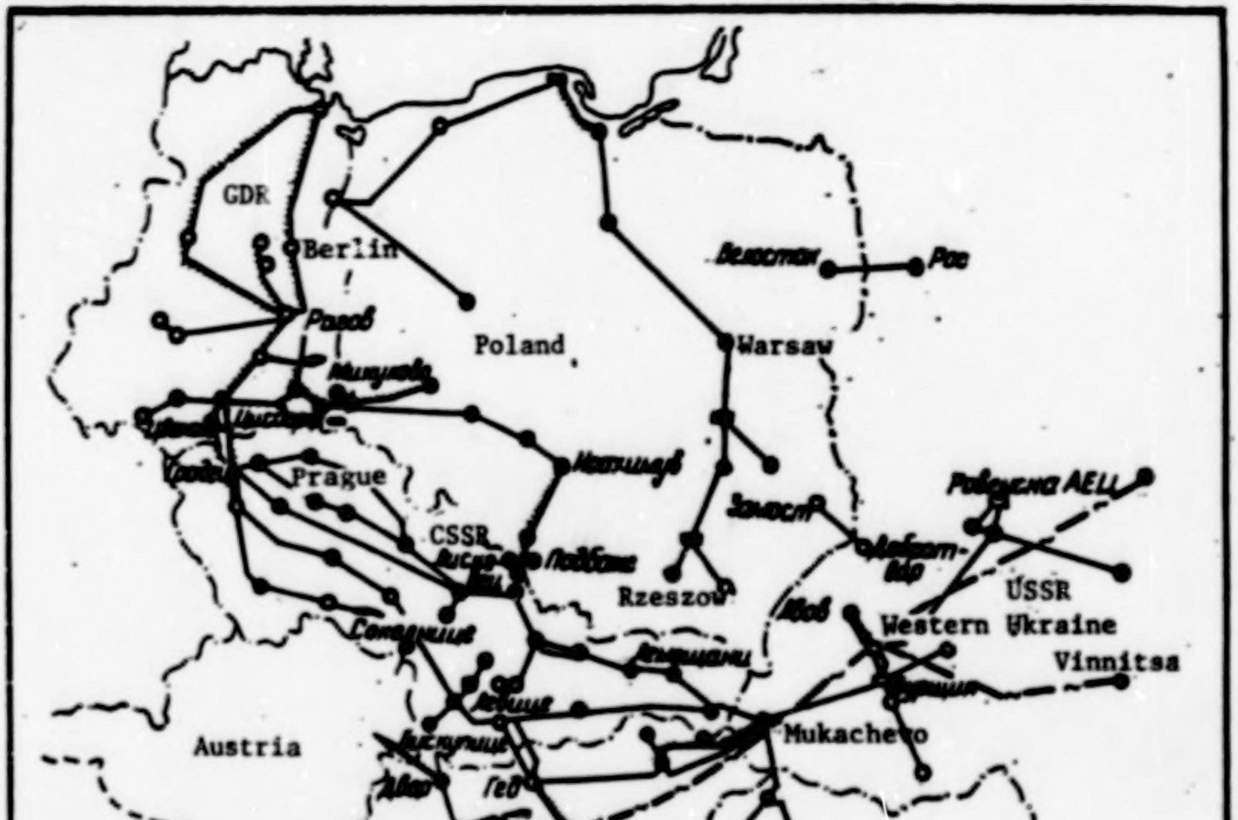


Diagram of United Power Systems

The Deva TETs in Romania

Thus the creation and further development of the CEMA UPS has been and remains the basic area for further improving the international socialist division of labor in power engineering. This provides an opportunity for the participating nations to realize a number of technical and economic advantages from the paralleling of the UPS, including increasing the reciprocal exchange of electric power, lowering the overall necessary capacity reserve in the power systems and raising the economicness of their operation and the reliability of power supply for the consumers.

Table 1

Basic Indicators for Development of Power Engineering in the CEMA Countries

Country	1 [illegible]			2 [illegible]			3 [illegible]		
	1955	1970	1980	1955	1970	1980	1955	1970	1980
Bulgaria	2,1	19,5	34,8	0,48	4,12	8,85	281	2290	4337
Hungary	5,2	14,5	23,6	1,11	2,73	5,41	576	1720	2890
GDR	28,7	67,7	98,8	5,9	12,57	20,45	1559	3970	5986
Cuba		4,9	9,4		0,89	2,05		574	959
Mongolia		0,5	1,5		0,22	1,41		440	1066
Poland	17,6	64,5	121,9	4,2	13,89	25,29	652	1980	3420
Romania	4,3	35,1	67,1	1,28	7.35	15,54	249	1610	3055
USSR	170,2	740,9	1295,0	37,2	166,15	270,00	868	3030	4798
CSSR	15,0	45,2	72,7	4,0	10,81	17,20	1137	3380	4855

Key: 1--Electric power production, billion kilowatt hour; 2--Installed capacity at plants, gigawatts; 3--Annual per capita consumption, kilowatt hours per inhabitant per year.

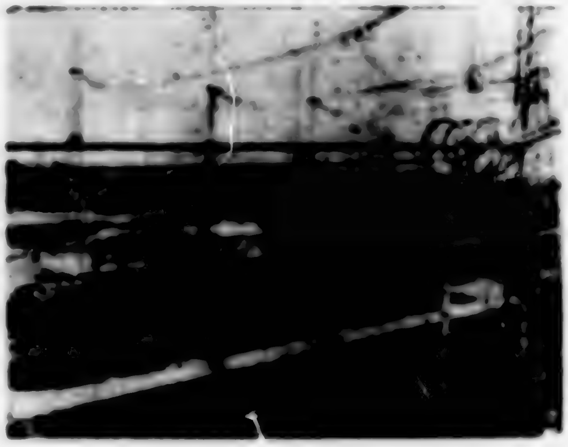
Of great importance for the development of the national power systems were the studies done within the commission to coordinate the long-range development plans for power engineering in the CEMA countries. This work has been used by the countries in drawing their five-year plans for national economic development as well as in coordinating the development plans for power engineering.

Of important significance for the development of the nations' power engineering was also the generalization of experience in the designing, construction and operation of power projects. This was carried out by the commission in the aim of introducing the most progressive achievements in this area.

The basic tasks and major areas for the further deepening and improvement of cooperation and the development of socialist economic integration among the CEMA countries over a period of 15-20 years were outlined by the Comprehensive Program adopted at the 25th CEMA Session (1971).

The carrying out of the Comprehensive Program and the LSCP stemming from it became the basic areas of the commission's activities in the following period.

The research conducted in the commission showed that for the further development of parallel operation of the UPS it was essential to increase the capacity of the intersystem links. According to the recommendations made in these studies in 1974, the concerned countries (Bulgaria, Hungary, the GDR, Poland, the USSR and CSSR) signed a General Agreement on the construction and operation of the first 750-kilovolt PTL between Vinnitsa--Western Ukraine (USSR)--Albertirsa (Hungary). The line was put into experimental operation in December 1978.



The Albertirsa substation in Hungary, the 750/400-kilovolt transformer

Simultaneously with the building of the 750-kilovolt PTL, upon the commission's recommendation, the intersystem links were strengthened between Hungary and the CSSR, ghe CSSR and Poland. Thus, by 1979 26 intersystem links had been built between the UPS members, including one with a voltage of 750 kilovolts, 13 operating at 400 kilovolts and 12 with a voltage of 220 kilovolts with a total operating capacity of around 15,000 megawatts.

With the completion of the superpowerful 750-kilovolt link, a qualitative new stage commenced in the parallel operation of the CEMA UPS. The limits of UPS parallel operation were significantly broadened. The entire joint power system of the USSR was connected to the parallel operations of the power systems in the fraternal countries and the transfer of power were increased. The reliability of the UPS parallel operation rose. An opportunity was created of achieving an intersystem effect from the combining of the load schedules of the nations and reducing their spare capacity. This provided a savings of 1,500 megawatts of installed capacity in the UPS power plants.

Of the greatest importance in carrying out the Comprehensive Program was the elaboration of the General Plan for the Long-Range Development of the CEMA UPS and the questions of cooperation in this area, including cooperation with the power system of Yugoslavia. The draft was basically approved by the 30th CEMA Session.

This document which was a major international project provides recommendations for the long-range development of the electric power systems in the individual nations and generally for the UPS. It outlines the specific ways for meeting the increasing need of the countries for electric power over the coming 15 years.

The plan envisages a number of integration measures such as the joint construction by the interested countries of the Khmel'nitskiy and Konstantinovskiy AETs [nuclear power plant] on Soviet territory, and the building of 750-kilovolt intersystem links between the Khmel'nitskiy AETs (USSR) and Rzeszow (Poland) and the Konstantinovskiy AETs--Mecin (Romania)--Dobrudzha (Bulgaria).

The General Plan provides recommendations on the further development of the UPS by building a northern 750-kilovolt branch for the USSR--Poland--GDR and GDR--CSSR--Hungary.

With the development of 750-kilovolt power links in the UPS conditions will be created for the further concentration of power production, the security of parallel operation and power supply will be substantially raised and there will be a significantly greater opportunity for realizing an economic effect from the unification of the power systems by introducing large and economic power units at the power plants and the realizing of an intersystem effect by the combining of the load schedules and capacity reserving. Here the savings from carrying out the intersystem effect has been estimated at around 4,500 megawatts by the year 1990.

For carrying out the recommendations of the General Plan on a sound legal and organizational basis as well as for further developing bilateral and multilateral cooperation for the individual specific projects and areas of cooperation, in 1977, the representatives of Bulgaria, Hungary, the GDR, Poland, Romania, the USSR and CSSR signed a General Agreement for Cooperation in the Long-Range Development of the CEMA UPS Up to the Year 1990.

During this period the commission and its working bodies undertook great practical activities on the questions of cooperation among the countries in the area of technical progress in power installations.

Table 2

Growth of Installed Capacity of Power Plants and Unit Capacity of Equipment

Country	1 Най-голяма инсталирана мощност на електроцентралите, MW				2 Най-голяма единична мощност на агрегатите, MW.			
	1955	1965	1975	1979	1955	1965	1975	1979
Bulg.	100	500	880	1050	25	150	220	220
Hung.	...	215	1655	1870	32	100	215	215
GDR	...	1300	2520	3020	32	100	220	500
Pol.	280	1400	2000	2600	55	200	200	500
Rom.	...	300	980	1860	50	150	315	330
USSR	610	2100	6000	6000	150	300	800	1000
CSSR	...	600	800	1200	50	110	200	200

Key: 1--Greatest installed power of power plants, megawatts;
2--Greatest unit capacity of equipment, megawatts.

Almost two-thirds of the total growth in the installed capacity in the power engineering of the CEMA countries and Yugoslavia over the entire period of cooperation is to come from power plants operating on organic fuel. For this reason, the role of cooperation in the area of thermal power engineering has been continuously growing.

During this period technical progress in thermal power engineering was chiefly aimed at increasing unit capacity of the equipment with supercritical steam parameters, increasing the reliability of their operation and upgrading the technical and economic indicators for the production of electrical and thermal power as well as to using full automation in running the basic and auxiliary equipment. These are the questions which determine the activities of the commission.

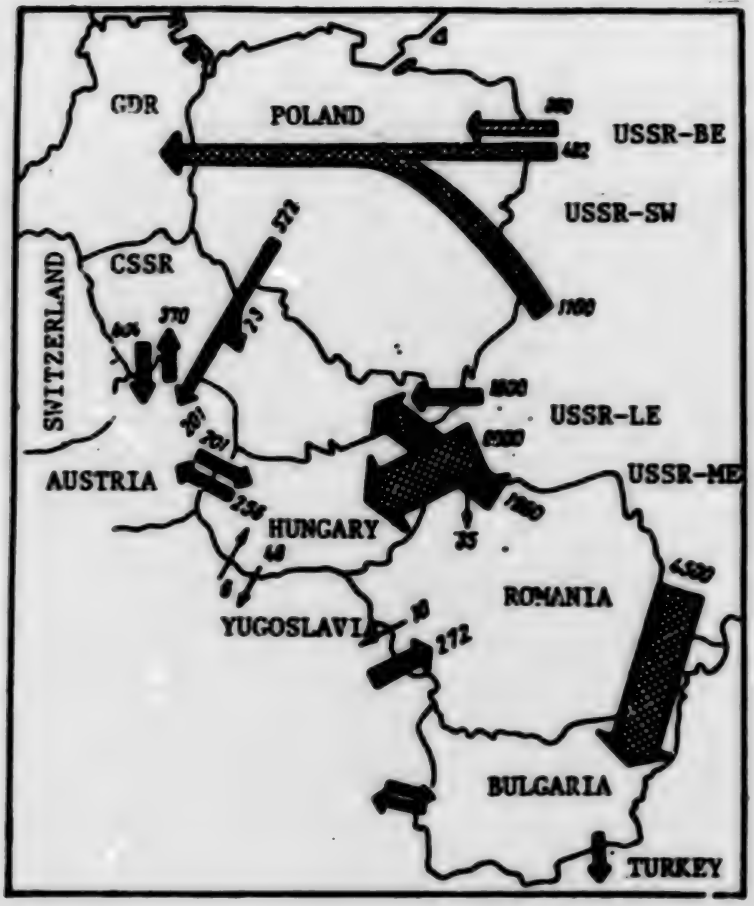
Within the commission tasks were also worked out for creating and utilizing large thermal power plants, including high-powered automated base power units at the TETs [thermal power plant], the basic equipment of the TETs and highly flexible power equipment on a basis of specialization and cooperation between the CEMA members in developing them.

In accord with the studies of the commission and in cooperation with the CEMA members, such major thermal power plants as Varna, Devnya, Maritsa-Iztok, Sofia and Bobov Dol in Bulgaria, Dunamenti and Gyongyos in Hungary, Tierbach, Hagenwerder and Bochsberg in the GDR, Darhan and Ulan Bator in Mongolia, Torow and Kozienice in Poland, Borzesti, Ploesti, Mintia-Deva and Galati in Romania and Prunerzov in the CSSR were completed.

The cooperation of the CEMA nations in the area of hydropower engineering began in 1956 when a commission was set up to exchange electric power and use the hydropower resources of the Danube River and this was later renamed the Permanent CEMA Commission for Power Engineering.

The development of plans to fully utilize the hydropower resources of the Danube (from the border of the CSSR to the mouth of the river) was completed in 1961. This became the basis for planning the development of water management and hydropower engineering for the Danubian CEMA countries and Yugoslavia.

The CEMA members have great reserves of untapped economic hydropower potential. For this reason the commission has conducted research on its fuller utilization and this would provide a significant saving in organic fuels for the nations.



Exchange of electric power in the UPS

Some of the largest hydropower projects built on the basis of research carried out by the commission are the power plants of the Batashkia hydropower series, Vucha, Belmeken--Sestrimo in Bulgaria, the Hohenwarta PAVETs [pumping-storage hydroelectric plant] in the GDR, the 16 February VETs [hydropower plant] in Romania, the Orlik VETs in the CSSR and the largest Iron Gates VETs on the Danube River with a power of 2,100 megawatts built by the joint efforts of Romania and Yugoslavia.

The research conducted within the commission has shown that with the intense rise of the peak load for the UPS and Yugoslavia there is a greater need to complete peak capacity. On the basis of materials from the nations, within the General Plan, research has been carried out and the appropriate recommendations given to solve the problem. For example, upon the proposal of the countries, it has been recommended that through the joint efforts of the involved countries construction be carried out on the following projects: the Lakatnik PAVETs in Bulgaria, Predikalosen in Hungary, Newistka in Poland and Dzerdap III in Yugoslavia.

At present the commission is conducting research on determining the effectiveness from the construction of PAVETs on a mutually advantageous basis and the dates for their construction. In view of their great maneuverability, their use in the UPS as an emergency and load reserve will be particularly effective.

Table 3

Total length of 110-kilovolt and higher PTL in the European CEMA nations, 1,000 km

Country	19.5		1965		1975		1979	
	total	inc. 400 kV	total	inc. 400 kV	total	inc. 400 kV	total	inc. 400 kV
Bulgaria	1,13	—	4,48	—	9,37	0,8	10,71	0,91
Hungary	1,65	—	3,37	—	6,11	0,51	8,63	1,0
GDR	7,8	—	15,6	1,3	22,46	2,46	24,5	3,48
Poland	6,0	—	17,32	0,32	29,8	1,0	33,6	1,63
Romania	1,5	—	6,32	0,38	17,31	2,33	—	—
USSR		—	184,5	16,03[1]	363,1	40,94[1]	444,03	53,55
CSSR	4,53	—	9,23	0,51	14,18	2,5	14,58	2,7

---

[1] Together with PTL with voltage of 400, 330, 500, 750, 800 (±400) kilovolt.

Cooperation among the CEMA nations in the area of nuclear power started in the 1960's. Extensive activities were undertaken to design and build a number of AETs not only in the USSR but also with Soviet aid in the CEMA nations.

The commission has focused attention on the deepening of scientific and technical cooperation among the CEMA countries in the area of nuclear power predominantly in solving the urgent problems of the designing, construction, safety, the development of special equipment and the operation of the AETs.

The basic questions in the cooperation among the countries have been raising the economicness, safety and maneuverability of the AETs and their equipment.

In accord with the recommendations of the CEMA Executive Committee and the proposals from the countries, the commission has worked out a number of subjects which are of the greatest practical interest.

Upon the proposal of the 26th CEMA Session within the commission a study was made on the questions of accelerating the designing and construction of AETs with water-cooled power reactors of 1,000 megawatts. These were the most important questions in the scientific and technical cooperation of the nations. These were incorporated in the LSCP.

The materials elaborated by the commission for cooperation in nuclear power are of great practical value and have been used by many nations in the construction and operation of the AETs.

At present the first nuclear plants built with Soviet assistance are in operation. These include: Kozloduy in Bulgaria, Rheinsberg and Nord in the GDR, Jaslovske Bohunice in the CSSR. Nuclear plants are being built in Hungary, Poland, Romania and Cuba.

In the commission work has also been started on introducing nuclear sources for centralized fuel supply (ATETs) and nuclear-powered boilers employing low-potential nuclear reactors for the CEMA countries.

For reducing the tension in coordinating the fuel and energy balance of the European CEMA countries, particular attention has been given to the intensive development of nuclear engineering in the General Agreement and in the sectorial section of the LSCP.

The carrying out of these activities commenced with the General Agreement signed in 1979 by the interested countries for cooperation in building the Khmel'nitskiy AETs with a capacity of 4,000 megawatts on Soviet territory and the agreement for cooperation in building and operating the 750-kilovolt PTL from the Khmel'nitskiy AETs to the Rzeszow substation in Poland covering a distance of 380 km. The plans of the agreement were drawn up in the commission.

At present the commission is drawing up draft agreements for the following integration projects: the Konstantinovskiy AETs with a capacity of 4,000 megawatts and a 750-kilovolt PTL which would be around 700 km long running as follows: Konstantinovskiy AETs--Maciu (Romania)--Dobrudzha (Bulgaria).

The building of the two nuclear plants by the joint efforts of the concerned countries will make a great contribution to solving the energy problems of the CEMA countries. The nations participating in the agreement will receive electric power in quantities proportional to their contribution to construction.

In 1977, with the direct participation of the commission, development was completed on a program for the maximum possible development of nuclear machine building in the CEMA countries for the period up to 1990. This was approved at the 31st CEMA Session.

The program clearly outlines the basic directions for specialization and cooperation in producing the equipment. Here consideration has been given to the experience of a number of countries in constructing the AETs and their capabilities. Of exceptionally great significance for the accelerated completion of capacity at the AETs and for improving their technical and economic indicators will be the carrying out of the agreement signed at the 23d CEMA Session for multilateral international specialization and cooperation in the production and reciprocal delivery of equipment for the nuclear power plants during the 1981-1990 period.

The countries will receive great help from the international Interatomenergo [International Nuclear Power] firm set up in 1973 for assisting in production cooperation, in delivering equipment and providing technical cooperation in building the AETs.

According to the AETs construction program under the mentioned agreement, around 50 major industrial associations and enterprises from all the European CEMA countries and Yugoslavia will be involved in the production and delivery of equipment.

Scientific and technical cooperation is the most important element in the intensely developing integration processes in CEMA power engineering.

The coordination of the most important scientific and technical power engineering research of mutual interest for the CEMA countries is one of the areas of activity for the CEMA PCCPEA and is carried out in accord with the countries' five-year plans worked out as a basis of multilateral cooperation.

The Bobov Dol TETs in Bulgaria built with assistance from the CEMA countries

The projects for scientific and technical development in the commission are aimed at solving the main long-range problems and ensuring the effectiveness of the conducted research.

A large portion of the subjects in the scientific and technical research is devoted to the questions of improving UPS parallel operations of the CEMA countries, the operation of power installations, increasing the safety of the electric networks and power installations, protecting the environment against the harmful impact of power installations and so forth.

Much of the research done by the commission has made a significant contribution to the development of power engineering in the CEMA countries. One of the most important research subjects has been the plan worked out in 1978 upon the recommendation of the CDA for the hardware and software support of the power systems in the countries participating in the CDA in providing the automation and controls. This is of substantial significance in organizing the parallel operation of the UPS and the USSR JPS.

In carrying out the comprehensive program and from the viewpoint of raising the effectiveness of cooperation in the area of scientific and technical information, an International Sectorial System for Scientific and Technical Information (MOSNTI) for Electric Power was founded in 1974.

The subjects of the MOSNTI for Electric Power include all areas in power engineering which are the concern of the Permanent Commission: power systems, TETs, VETs, AETs and all types of scientific research on power engineering questions.

The commission devotes a great deal of attention to cooperation with third countries. Within the commission research is being carried out on the possibilities of unifying the power systems of Eastern and Western Europe and this is used by the representatives of the CEMA PCCPEA in their participation in sessions of the Committee on Electric Power under the UN Economic Commission for Europe.

The commission takes an active part in working out a number of intersectorial questions stemming from the Comprehensive Program, in particular in working out the questions of environmental protection, the elaboration of forecasts for the demand for fuels and electric power for 1990 and up to the year 2000, in solving questions related to the production of the basic and auxiliary energy facilities and the development of cooperation among the countries in the area of the most efficient and economic use of fuels and electric power in the national economy.

The achievements of the CEMA countries in the development of power engineering provide an objective description of the effectiveness of their 25-year cooperation within the CEMA PCCPEA.

During the period of 1955-1980, electric power production in the European CEMA countries increased by 6.7-fold. During the same period this increase for the Common Market countries was 3.9-fold. Per capita electric power production in 1979 in the CEMA countries surpassed the average world level by 2.4-fold.

The rapid increase in installed capacity has been achieved by completing new large power plants, predominantly thermal ones. A large portion of them has been built with the fraternal cooperation of the countries on a multilateral and bilateral basis. Simultaneously with the increase in the capacity of the power plants the unit capacity of the equipment has risen.

The development of power engineering in the CEMA countries has been accompanied by the intense construction of high-voltage power transmission networks and by a changeover to higher voltages.

This is clearly seen from the data shown in the three tables and the diagrams showing the development of the UPS networks.

The formation of the UPS has been accompanied by the development of intersystem links of 220 and 400 kilovolts and by the completion of the first 750-kilovolt intersystem line between the USSR and Hungary. With a rise in the operating capacity of the intersystem links, there has been a significant increase in the exchange of electric power between the CEMA power systems. Over the last 20 years, the international exchange of electric power between the member nations of the CDA has increased by more than 18-fold.

The basic task of the commission during the period up to 1990 is the all-round development of cooperation among the countries in carrying out the measures outlined by the LSCP in the area of power engineering. Their implementation at the present stage allows one to conclude that they are indisputably effective for the participating CEMA nations and that it is possible to carry out the specific decisions which will aid in ensuring sufficient electric power for the CEMA countries with the least loss of time and social labor.

The specific measures to further develop parallel operation of the CEMA power systems, as is stated in the General Plan, have been examined above. This will involve the building of a number of integration projects such as high-powered intersystem links with a voltage of 750 kilovolts, two AETs on Soviet territory and system-wide storage hydropower plants.

The recommendations on the further development of generating sources and cooperation in this area have been provided in the drafts given in the commission's studies for the Basic Trends in the Long-Range Development of Generating Power Capacity in the CEMA Countries and Yugoslavia for the Period Up to 1990 and the Basic Directions in Technical Progress in the Designing, Construction and Operation of TETs in the Period Up to 1980 and the Trends to 1990 as stemming from the Comprehensive Program.

In the immediate years, with Soviet technical assistance, nuclear plants will be built in Bulgaria, Hungary, the GDR, Poland, Romania and the CSSR with a total capacity of 10,000 megawatts. The nuclear plants will operate with the well-developed water-cooled thermal reactors with a capacity of 440 megawatts and then up to 1,000 megawatts. Their series production is being developed by the joint efforts of the countries. Such units are being installed in a number of the Soviet AETs. The first VVER-1000 reactor is already in operation in the Novovoronezhskaya AETs.

In the USSR, in operation are the two first power units of the Leningrad AETs with boiling-water channel reactors with a capacity of 1,000 megawatts each (RBMK-1000) and the preliminary plans have been worked out for a similar reactor of 1,500 megawatts the first of which will soon be installed in the USSR.

In accord with the agreement on multilateral international production specialization and cooperation and reciprocal deliveries of equipment for the AETs in 1981-1990, the nations will meet their obligations to carry out the designated program of building AETs with Soviet technical assistance on the territory of the CEMA countries with a total power of around 37,000 megawatts.

An inseparable part of integration among our nations in the area of power engineering is the broadening and deepening of scientific and technical cooperation and its ever-closer link with the production forms of cooperation. Research will be continused to protect the atmosphere from harmful waste products from the TETs.

For successfully carrying out the outlined programs up to 1990, the CEMA PCCPEA has acquired great unique experience in cooperation where the interests of each nation are combined harmoniously with the interests of the association. This leads to the more complete and more dependable power suply of each individual power system in the CEMA countries and to the more dependable and flexible operation of the entire UPS.

This experience reaffirms the prediction of V. I. Lenin that socialism "...will create new, higher forms of human intercourse where the legitimate needs and progressive aspirations of the working masses of all nationalities will for the first time be satisfied in an international unity..." (V. I. Lenin, PSS [Complete Collected Works], Vol 26, p 40).

10272
CSO: 2200/112

DEVELOPMENT OF POWER ENGINEERING IN BULGARIA TRACED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 15-19

[Article by Nikola Todoriev, Bulgarian minister of power and leader of the Bulgarian delegation to the CEMA PCCPEA: "The Scale and Pace of Power Engineering Development in Bulgaria"]

[Text] Our nation has entered the Eighth Five-Year Plan with a strong energy base and sufficient power generating capacity of a high technical level and with significant production-technical, economic and scientific-technical potential and highly skilled personnel capable of successfully carrying out the evermore complex tasks posed by the dynamic economic development.

In solving the main problem at our present stage of fully satisfying the constantly growing material, spiritual and social needs of the people, on a basis of the intensification of the national economy, the consistent application of the new economic approach and its mechanism and the broadest introduction of the achievements in scientific and technical progress, power engineering has particularly responsible tasks. This determines its high rate of development in the subsequent period as outlined in the decisions of the 12th BCP Congress.

The Bulgarian national energy complex has been developing in accord with the long-range program that outlines the basic paths for meeting the energy requirements up to 1990 and beyond.

The program reflects the succession in the basic principles of our energy policy from the first years of communist rule and based upon Lenin's teachings about electrification and the remarkable ideas of Georgi Dimitrov concerning its place during the transitional period from capitalism to socialism. The basic premises for its successful execution are, in the first place, the capacity we received from the previously created power base and, secondly, the deepening of cooperation with the nations of the socialist commonwealth.

Under the conditions of a capitalist system, not only power engineering but also the entire Bulgarian national economy were extremely backward. For decades there was virtually no development in the nation's power system. The basic source of energy was primarily animal and human strength, wood was largely used as fuel while the coal industry was very little developed.

Electrification of the nation was at its very beginning, without any integration and with separately operating small numerous hydraulic and diesel power plants and several low-power thermal plants.

The per capita consumption of electric power was annually scarcely 45 kilowatt hours.

After the victory of communist power on 9 September 1944, Bulgaria set out on a socialist path of development.

The first years after liberation were years of national economic reconstruction. The first steps were taken in the development of power engineering and primarily the coal industry and electrification. After 9 September the first thermal plants began to be built operating on local coal. These were the Sofia TETs [thermal power plant], the Republika TETs and the Maritsa-3 TETs. A start was made on using the hydropower potential by building comparatively small capacity hydropower plants, predominantly below irrigation and water supply reservoirs as well as the harnessing of running and day-leveled water.

A major role in the development of power engineering was played by the historic April Plenum of the BCP Central Committee in 1956; our entire community is celebrating its 25th anniversary this year.

The basic directions were outlined for the development of power engineering during the stage of building a developed socialist society. In realizing the crucial role of power engineering for the accelerated and dynamic growth of the national economy and for the broad application of scientific and technical progress, the party and the government planned more rapid development rates for it and this ensured its transformation into a leading economic sector.

The other basic factor of crucial significance for the construction of a modern energy base in Bulgaria has been the development of multilateral cooperation with the socialist countries in the area of power engineering.

One of the first bodies of CEMA which was founded in 1949 was the Commission for the Exchange of Electric Power and the Use of Hydropower Resources of the Danube River (1956) which later, in 1958, developed into the Permanent CEMA Commission for Power Engineering [CEMA PCCPEA]. Bulgaria has been a member of this commission since its inception.

For more than a quarter of a century, due to the activities of the CEMA PCCPEA in the area of the multilateral and bilateral coordination of the five-year and annual economic development plans of the CEMA countries, the demand of the national economy, material production, the service sphere and the municipal-household sector for electric power has been fully satisfied.

In 1955, our electric power consumption was 2.1 billion kilowatt hours, while on a per capita basis there were 281 kilowatt hours annually. In 1980, this consumption had risen to 38.7 billion kilowatt hours which is 19-fold more, while specific electric consumption reached around 4,400 kilowatt hours a year, or an increase of 16-fold.

Characteristic for the development of the nation's power consumption has been its high rate, particularly during the period up to 1970. This was due to the high development rate of the entire national economy, the low base from which the construction of the power industry started as well as the absence of other local highly efficient energy resources such as liquid fuel, natural gas and high-calorific coal for directly satisfying the energy needs of the nation.

Since 1970, there has been a tendency for a decline in the average annual development rate of electric consumption. This has been due to the overcoming of the national economy's backwardness and the conversion of the economy from a predominantly agrarian one into an economy with a pronounced industrial nature.

The energy resources which our nation possesses are limited. The oil and natural gas reserves are insignificant while the coal reserves are characterized by a high ash content, great wetness and low caloricity. These quality indicators for the coal resources point to their use primarily in the production of electric and thermal power and here in large steam generators with a high unit capacity.

Bulgaria's hydropower resources are also limited. We have better conditions for the construction of peak hydropower plants operating on controlled water with comparatively high drops and low water quantities with a low annual use factor for the installed capacity.

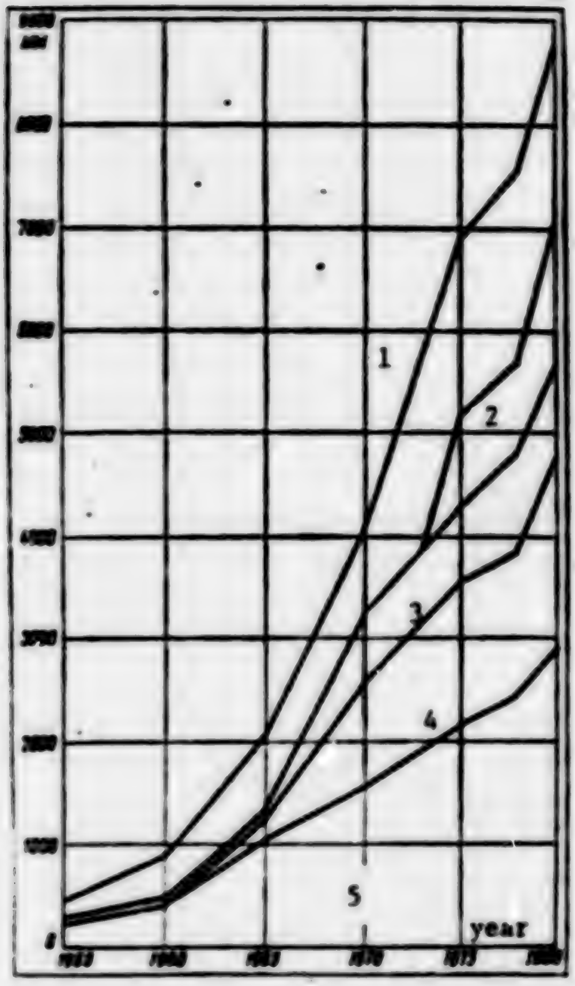


Fig. 1. Growth of installed capacity and change in its structure over the last 25 years

Key: 1--VETs; 2--AETs; 3--Gas and mazut-fired TETs; 4--TETs operating on imported coal; 5--TETs operating on local coal.

Regardless of the rapid growth of electric generating capacity operating on local fuels and the hydropower plants, the nation's electric power balance over the last 15-17 years has been in balance due to the importing of certain amounts of electric energy from the USSR and the production of electric power from plants burning imported coal as well as imported liquid and gaseous fuels.

The production of electric power in the nation in 1955 was 2.07 billion kilowatt hours, of which 68.7 percent came from the TETs and 31.3 percent from the VETs [hydropower plant].

In 1980, electric power production reached 34.84 billion kilowatt hours, that is, close to 17-fold more than power production in 1955. In 1974, our nation began using nuclear power.

The electric production structure in 1980 was significantly changed in comparison with 1955. There was a substantial rise in the share of production from nuclear engineering, some 17.7 percent of the total electric production, while the relative share of production from the VETs dropped to 10.7 percent while that of the TETs increased to 71.6 percent.

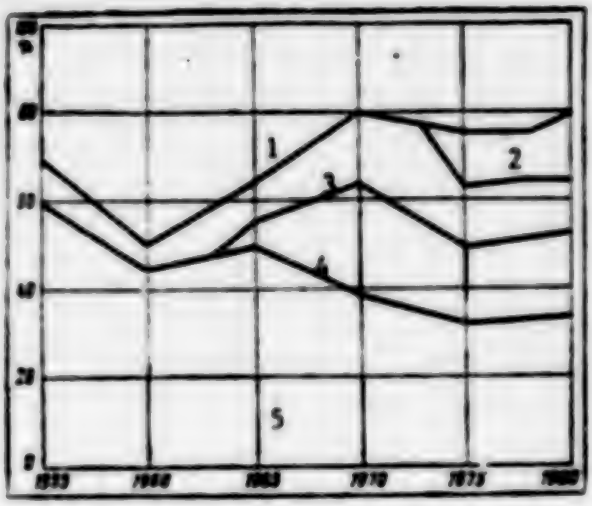


Fig. 2. Percentage participation of different of power sources in total installed capacity

Key: 1--VETs; 2--AETs; 3--Gas and mazut-fired TETs; 4--TETs operating on imported coal; 5--TETs operating on local coal.

In recent years a policy has been consistently carried out of a maximum reduction in electric power production from plants fired by mazut and natural gas. Out of the total increase in electric power production at the TETs under the Ministry of Power during the Seventh Five-Year Plan, only 1.2 percent came from mazut- and natural gas-fired plants, while the increase in the production from factory plants which predominantly employ imported fuels and mainly liquid and gaseous ones was scarcely 3.4 percent, with an average of around 6 percent for the nation.

This was the result of the clearly designated line in the energy policy of the Ministry of Power for a maximum savings in the highly efficient liquid and gaseous fuels. This has led to a decline in the consumption of liquid fuels and natural gas for energy output and the channeling of them into national economic sectors where their use is more efficient.

The import and exchange of electric power between Bulgaria and the neighboring countries started in 1950, when we still did not have a unified power system. The first step was the completion of a 60-kilovolt cable line between Ruse and Giurgiu across the Danube River. After 1972, the impor ing of electric power with the completion of the intersystem 400-kilovolt link between the Moldavian power system and the Bulgarian power system across Romanian territory played a substantial role in coordinating the electric power balance. The maximum participation of imported electric power for satisfying the needs of the nation in 1974 reached about 15 percent, after which this participation gradually declined and the volume of electric power imports has settled at 4.5 billion kilowatt hours.

Over the 25 years the installed capacity rose to 8,400 megawatts or more than 19-fold.

Due to the cooperation and fraternal aid of the CEMA countries, and primarily cooperation between the USSR and Bulgaria, we have achieved great advances both in the development of thermal power engineering as well as in the construction of VETs. Over 80 percent of all the nation's energy capacity has been built with Soviet equipment and with the direct involvement of Soviet specialists as well as with aid from a number of the socialist countries.

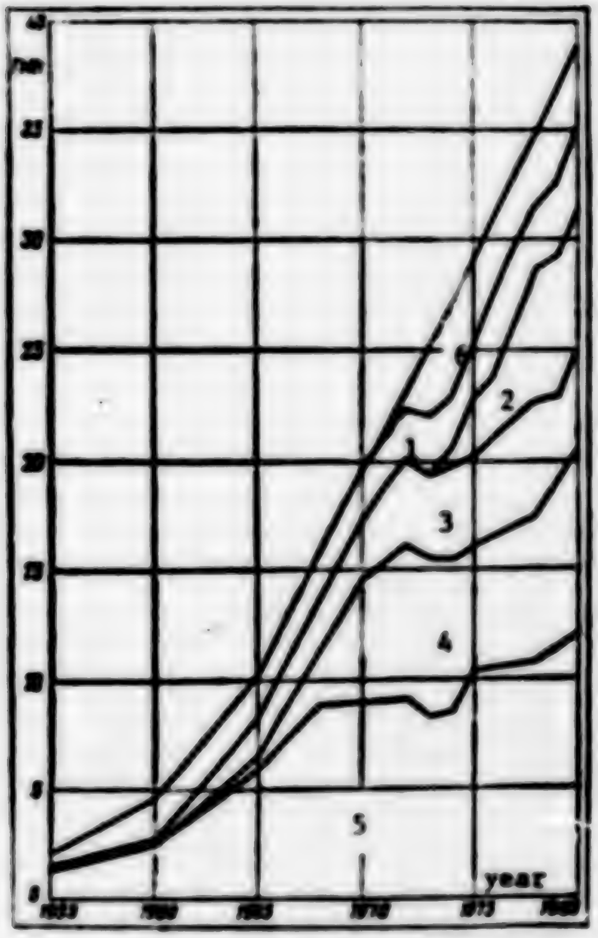


Fig. 3. Rise in electric production and electric consumption and the structure of power-generating capacity

Key: 1--VETs; 2--AETs; 3--Gas and mazut-fired TETs; 4--TETs operating on imported coal; 5--TETs operating on local coal; 6--Import-export balance.

A vivid example of the great impact from cooperation between the CEMA nations was the construction of the Bobov Dol TETs which has three power units of 210 megawatts each. These were completed during the years of the Sixth Five-Year Plan (1971-1975). The plans for the plant were worked out by the Bulgarian design institute Energoproekt, the steam generators and the coal delivery equipment were provided by Poland while the turbines, generators and generator transformers came from the USSR. The remaining equipment was produced and delivered by producing plants in the GDR, CSSR, Hungary, Yugoslavia as well as from enterprises in our nation.

In the Seventh Five-Year Plan alone our nation built close to 2,000 megawatts of new electric generating capacity. These are concentrated predominantly at three major projects, the expansion of the Varna TETs with three 210-megawatt power units, three 210-megawatt units at the Maritsa-Iztok-3 TETs with a final designed capacity of 840 megawatts and the expansion of the Kozloduy AETs with one 440-megawatt VVER reactor.

There are two particularly characteristic aspects in the development of power engineering in our nation during the Seventh Five-Year Plan: the introduction in thermal power practices of a new method for the direct combustion of high-ash low-calorific lignite coals from the Maritsa-Iztok complex in the Maritsa-Iztok-3 TETs

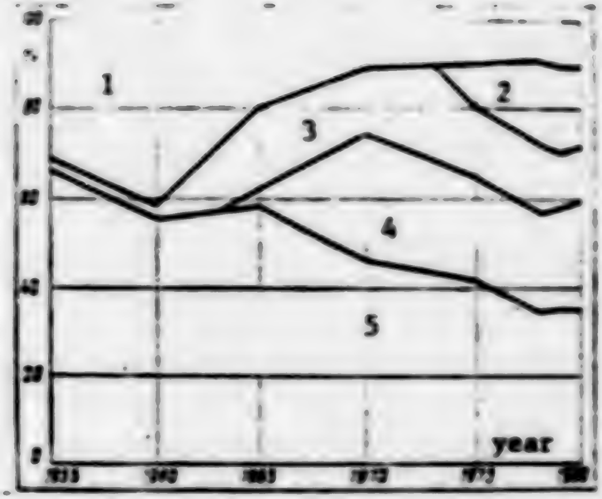


Fig. 4. Percentage of different power sources in total electric production

Key: 1--VETs; 2--AETs; 3--Gas and mazut-fired TETs; 4--TETs operating on imported coal; 5--TETs operating on local coal.

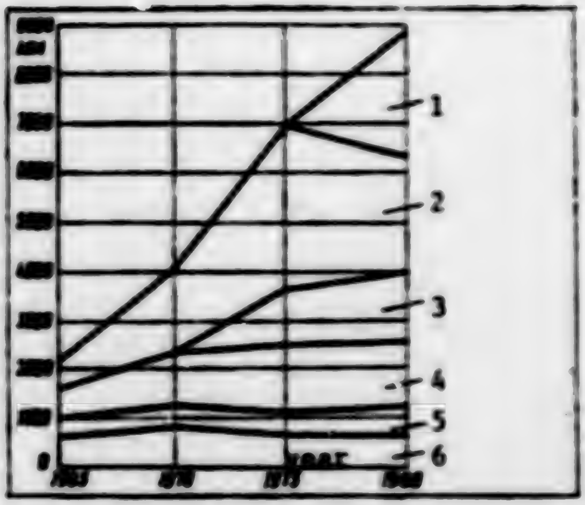
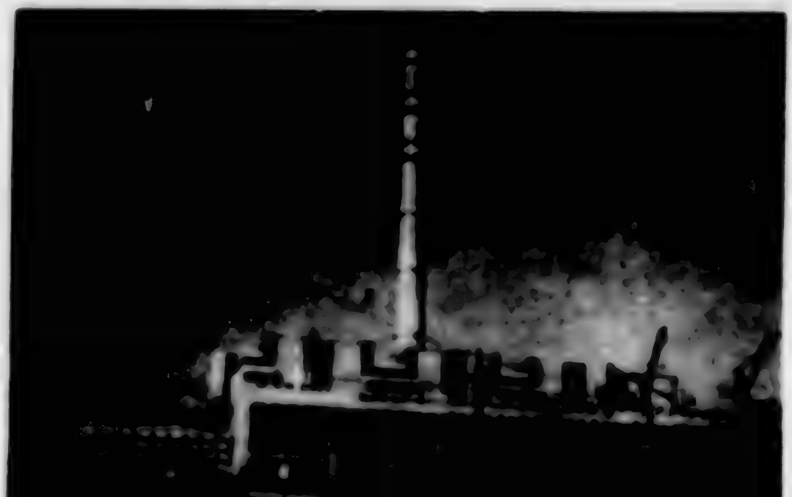


Fig. 5. Structure of installed electric generating capacity by unit capacity of plants

Key: 1--Over 1,000 megawatts; 2--From 500 to 1,000 megawatts; 3--From 200 to 500 megawatts; 4--From 100 to 200 megawatts; 5--From 50 to 100 megawatt; 6--To 50 megawatt.



without the construction of a drying plant and without preliminary drying of the fuel. This realizes a significant savings in capital investments and very good technical and economic indicators are achieved in comparison with the first two plants burning the same coals.

With the solving of the problems involved in the burning of the Maritsa-Iztok lignite coals nearly 20 years ago, our nation became a pioneer in utilizing fuels with similar quality indicators.

The second major success of Bulgarian power engineering during the Seventh Five-Year Plan was the starting up and stabilizing of operations at the AETs. In less than a year the AETs reached its designed indicators and during the last 2 years of the five-year plan reached an annual utilization of installed capacity of over 7,000 hours.

Along with the construction of electric generating capacity, there has also been extensive development of the entire power network system. While in 1955, we had in operation electric lines with the highest voltage of 110 kilovolts and a length of 1,132 km, in 1980, their length reached 7,418 km with the 110-kilovolt system now performing distribution functions while transmission was carried out at a voltage of 400 and 220 kilovolts. In operation are 1,023 km of 400-kilovolt power transmission lines [PTL] and 2,608 km of 220-kilovolt lines.

The concentration, on the one hand, of generating capacity at several large power plants and, on the other, of the electric loads in the large cities have necessitated the building of 110-kilovolt urban substations which are playing a more important part in the load schedule with the direct transforming of 400/110 kilovolts. In this method it is possible to avoid the 220/110-kilovolt transforming and greater efficiency is achieved in the transmission and distribution of electric power.

The Bulgarian electric power system is connected by several PTL with the electric power systems of the neighboring countries. Three 110-kilovolt PTL are in operation connecting the substations of Bulgaria and Yugoslavia: Kula--Bor, Breznik--Vurla and Petrich--Strumitsa. One 220-kilovolt PTL has been built between the Romanian and Bulgarian power systems: the Kozloduy AETs and Craiova. Through this our power system is connected to the United Power Systems [UPS] of the CEMA countries. Three high-powered 400-kilovolt intersystem PTL have been built: from the Moldavian Power System over the Vulkanesti--Dobrudzha 400-kilovolt PTL, with Yugoslavia over the Stolnik--Nis line, and with the European part of the Turkish Power System from the Maritsa-Iztok-3 TETs to Babaeski. These intersystem links create conditions for exchanging electric power and providing mutual aid under emergency conditions.

A particularly essential role in the stable and dependable operation of the power system is played by the power line links with the power systems of Moldavia and Romania and through them our system operates in parallel with the Peace UPS and the USSR JPS [Joint Power System]. With the completion of the 220-kilovolt Boychinovtsi --Craiova PTL link in 1967, the Bulgarian Power System was connected to the association of European CEMA power systems set up in 1962.

The future development of Bulgarian power engineering, as clearly and far-sightedly outlined by the recently held 12th BCP Congress is characterized by three general areas:

The fuller development of local energy resources. As the basic source for producing energy in the future the plans are to utilize the lignite coals and develop nuclear power with the relative share of the electric power produced by the AETs continuously increasing in the nation's electric power balance;

An improvement in the efficient use of fuels and energy in all spheres of consumption and a further decisive reduction in the energy intensiveness of production, rationalizing the structure and energy consumption and reducing energy consumption for the creation of a unit of national income.

Over the long run an important place will be given to the further development of centralized heat supply and for this purpose mainly local solid fuels will be used, and in the more distant future, nuclear power.

According to the preliminary estimate, total energy consumption is to rise from 42 million tons of conditional fuel units in 1980 to 48-50 million in 1985 and 55-60 million tons in 1990.

The basic task confronting power engineering during the Eighth Five-Year Plan (1981-1985) and up to 1990 is to supply material production and the service and domestic sphere with the required electric and thermal energy while at the same time seeing to it without fail that this is done with the least possible consumption of the material and labor resources and a maximum utilization of production capacity.

In 1985, the nation's electric energy production should reach 46 billion kilowatt hours, and in 1990 should rise to around 60 billion.

Of particularly important significance for successfully carrying out the energy program during the 1981-1985 period and up to 1990 are the construction and completion at the designated dates of production capacity not only in energy production but primarily in the coal mining industry.

For ensuring normal electric supply for the nation during the Eighth Five-Year Plan 2,500 megawatts of new electric generating capacity must be built and put into operation. The major projects include: the expansion of the Maritsa-Iztok-2 TETs with two 210-megawatt power units, a fourth 210-megawatt unit at the Maritsa-Iztok-3 TETs, a fourth 440-megawatt reactor and the first 1,000-megawatt reactor at the Kozloduy AETs.

During the Ninth Five-Year Plan the most significant and crucial projects will be the increasing of capacity at the Maritsa-Iztok complex by building the Maritsa-Iztok-4 TETs with a designed capacity of 1,000-1,500 megawatts and capacity at the Kozloduy AETs by adding still another 1,000-megawatt reactor as well as building nuclear capacity at a new site for the second Bulgarian nuclear plant.

Work will be continued on building the Nikopol--Turnu Magurele Hydropower Complex together with Romania, as well as our unique Chaira PAVETs [pumping and storage hydropower plant].

The nation's network system will also undergo further development. The 400-kilovolt ring will be closed. There is to be further expansion of the intersystem links by creating a 750-kilovolt PTL link between the USSR, Romania and Bulgaria and the linking of our power system with the Greek system via a 400-kilovolt PTL.

The further development and deepening of the integration processes in the area of power engineering and close and fraternal cooperation between the CEMA countries are the dependable guarantee for carrying out the grandiose tasks powed by the 12th BCP Congress for the development of Bulgarian power engineering.

10272
CSO: 2200/112

PRESENT STATE, PROSPECTS OF HUNGARIAN POWER DEVELOPMENT

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 21-25

[Article by Lazlo Kapoly, state secretary of the Hungarian Ministry of Industry and leader of the Hungarian delegation to the CEMA Permanent Commission on Cooperation in the Area of Power Engineering: "The Present State and Prospects of Hungarian Power Engineering Development"]

[Text] In the last decades, Hungarian power engineering has developed rapidly in meeting the nation's increasing demand for power without significant problems. The maintaining of this rate has been possible both by utilizing our own resources as well as due to mutually advantageous cooperation with the CEMA countries.

At the present stage, the development of power engineering is linked to a constant reduction in energy consumption per unit of national income. However not all the possibilities have as yet been used in this area.

The sharp rise in the prices for primary energy resources on the international market and which has meant a deterioration of the nation's trade has also had a significant impact on the balance of the Hungarian national economy. The price for oil and oil products on the world market has increased by more than 10-fold in comparison with 1973 while the specific consumption for the construction of large power projects has risen by 4-5-fold. This has necessitated the taking of decisive measures to reduce energy consumption by altering the production structure and increasing its efficient use.

The problems of the rational use of energy have been at the center of attention for the party and government bodies. Proposals and instructions have been worked out to determine energy policy during the following years and over the long run. The basic aim of this policy has been the full utilization of our own energy resources, the more efficient use of energy, greater saving of energy and particularly oil products and a reduction of its consumption.

In carrying out these tasks an important role is played by Hungary's participation in socialist economic cooperation in all energy areas.

The Tasks in the Area of Utilizing Energy as Formulated in the Fifth Five-Year National Economic Plan for 1976-1980 and the Results of Carrying Them Out

The chief direction in economic policy during the Fifth Five-Year Plan was an increase in the efficiency of social production through the better utilization of the productive capital and increased labor productivity and through reducing material expenditures in production and increasing energy savings.

In 1980, total energy consumption in the nation should have reached 1,348 PJ with an annual increase of 0.45 percent. Actual energy consumption in 1980 reached 1,260 PJ which, in comparison with the 1975 consumption of 1,080 PJ meant an average annual rise of 3.1 percent (Fig. 1). As one can see, the increase in energy consumption in the national economy is less than the planned. Actual energy consumption in 1980 was less than the planned amount by a difference equal to 2 million tons of oil.

In 1980, electric power consumption was planned for 35 billion kilowatt hours in comparison with 24.4 billion kilowatt hours in 1975. This meant an average annual increase of 7.4 percent. In 1980, actual electric power consumption reached 30.9 billion kilowatt hours, that is, 4.1 billion kilowatt hours than the planned. The actual average annual increase reached 4.8 percent (Fig. 2). The increase in the consumed energy in the national energy, including electric energy, during the planned period did not conform to the plan. Prior to 1977, energy consumption increased in accord with the plan, in 1978, it exceeded the planned amount and after this year remained on the same level. Prior to 1978, electric power consumption showed the same trend. In following years a minimum increase was recorded (Table 1).

Table 1

	1975	1976	1977	1978	1979	1980
Energy consumption in nation, PJ	1080	1126	1180	1260	1260	1260
Annual increase, %		4.3	4.7	6.9	0.3	---
Electric power consumption, billion kilowatt hours	24.4	25.9	27.6	29.9	30.3	30.9
Annual increase, %		6.1	6.6	8.3	1.3	1.9

Prior to 1978, the production increase rate in the national economy was higher and the production structure was better and because of this the growth in the demand for energy and electric power was greater than was desirable from the viewpoint of an equilibrium between the changed economic conditions and national economic development. Under these conditions the activities relating to the economic and rational use of energy were unable to produce significant results. Along with various other factors, the reason was that the government bodies were delayed in taking strict and effective economic measures to save energy after the sharp price increase for energy resources on the world market.

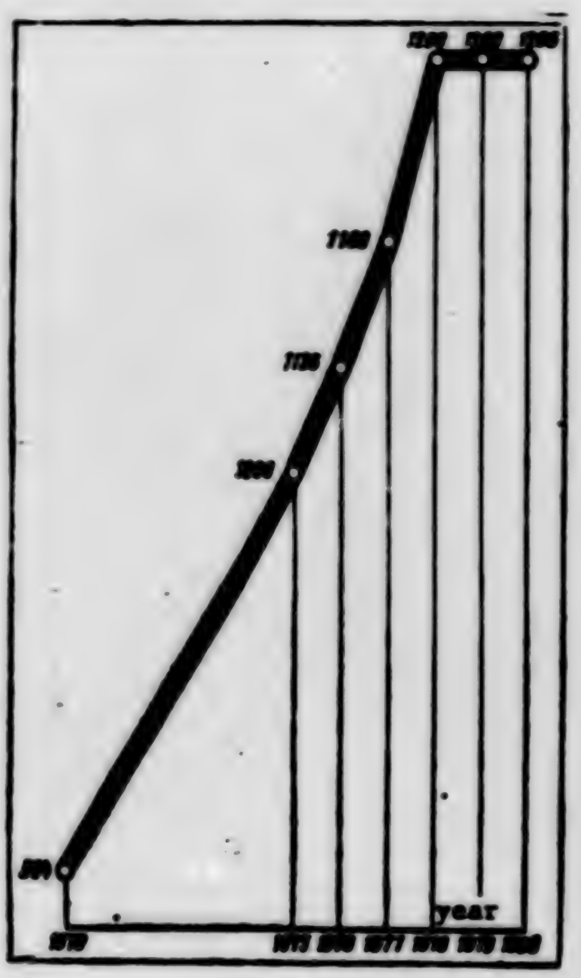


Fig. 1. Energy Consumption in Hungary (1970-1980)

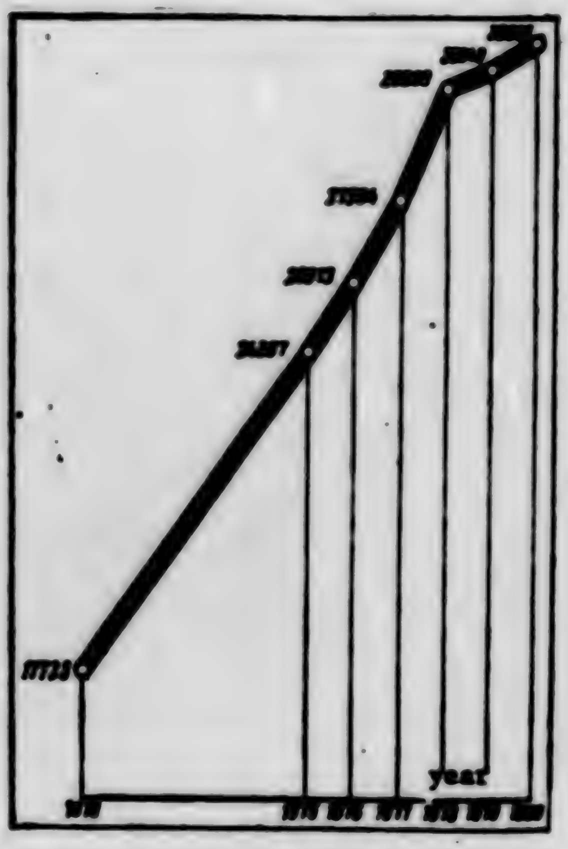


Fig. 2. Electric Power Consumption in Hungary (1970-1980)

For the individual types of energy resources, the following results were achieved:

Coal mining in 1980 was 25.7 million tons instead of the planned 24 million tons.

In considering the coal imports, the share of its consumption in total energy consumption in the nation surpassed the planned, reaching 29.2 percent instead of 26-28 percent. During each year of the five-year plan coal output exceeded the planned indicators predominantly due to output on days off. At the same time due to the absence of funds, the production capacity in coal mining did not achieve the growth which would meet our needs.

Oil output over the entire planning period conformed to the plan and reached 2 million tons. At the same time, the oil imports were 2 million tons less than the planned and in 1980 reached 7.5 million tons. For this reason oil refining in 1980 was 2 million tons less than the planned. In practice the decline in the nation's energy consumption in 1980, in comparison with the planned (1,260 instead of 1,348 PJ) was achieved entirely due to the decline in the amount of oil products. Thus, the share of oil and oil products in the nation's energy balance was significantly less than the planned (40-41 percent) and reached 25.6 percent.

The output of natural gas during the individual years of the five-year plan exceeded the planned. The importing of oil products was compensated for by the above-planned use of natural gas.

The national output which in 1980 reached 6 Gm^3 and the imports totaling 4 GM^3 corresponded to the plans.

The increased natural gas imports from the Soviet Union became possible due to the Fraternity Gas Pipeline which was built by the joint efforts of the CEMA countries.

In 1980, natural gas reached 26.6 percent in the nation's balance and exceeded the planned amounts by 24-25 percent.

The broadening of the electric power sources during the Fifth Five-Year Plan was achieved by building the Dunamenti TETs, the new Tisza VETs as well as by increasing the imports from the USSR. Of great importance for Hungary was the starting up of the 750-kilovolt line between Vinnitsa and Albertirsa. The line provided an opportunity to double the importing of electric power. With its construction paralleling was achieved in the United Electric Power Systems [UPS] of the CEMA nations and the Soviet Joint Power System [JPS].

This has necessitated more disciplined operations in comparison with the activities in the previous period both in the nation's system and on the international level. The technical and economic conditions needed for this as outlined by Hungary for the planned period were carried out.

Summary of Results from the Power Policy During the Period of the Fifth Five-Year Plan from 1976 to 1980

Since 1979, as a result of the change in the economic tasks and the tasks of energy policy, the increase in energy consumption has slowed down in comparison with the first half of the 5-year period. Energy consumption during the 1979-1980 period essentially did not increase. In the energy resource structure, imports of petroleum and oil products declined.

In absolute terms there was also a decline in the refining of oil products and the consumption of some of them. The decline in the demand for electric power made it possible to put off the construction of individual power plants. This necessitated a reworking and altering of the concepts in the program for electric capacity construction. As a result of several years of preparatory work, an economic energy program has been completed for the Sixth Five-Year Plan for the period of 1981-1985. Its fulfillment will ensure a decline in the energy demand in the national economy which, in turn, will reduce the growth rate of energy consumption and the expenditures of the national economy in the energy area.

The Present State of Power Engineering and the Main Principles of Hungarian Energy Policy for the 1981-1985 Period

Our policy in the power engineering area for the Sixth Five-Year Plan has been determined by the following conditions.

In proceeding from the conditions in the nation, imports to satisfy the energy requirements during this period will not decline significantly. At the same time, it is essential to bear in mind that the tendency for an increase in the prices for energy resources on the world market will continue. For this reason, by applying the necessary measures in the area of energy policy, it is essential to create conditions which will guarantee the further development of the economy with the deepening deterioration in the balance of trade.

Another trend which is observable in the world and is related to the change in the energy use structure is the increase in the relative expenditure of capital investments in the energy area.

Under these circumstances it is essential to carry out a flexible, active and combined energy policy. In the development of the Hungarian economy and power engineering greater and greater significance is being assumed by reducing the energy requirements, by the broader and more effective use of our own energy resources, by increasing the use of secondary energy resources and waste energy, as well as by substituting expensive imported oil and oil products in producing thermal energy and as a fuel by employing cheaper local energy resources.

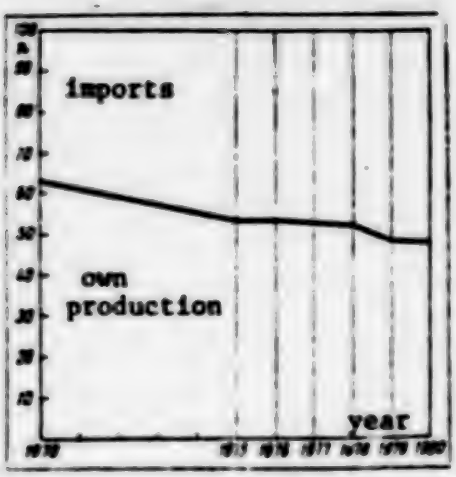


Fig. 3. Ratio of imports and local production of energy resources in Hungary (1970-1980)

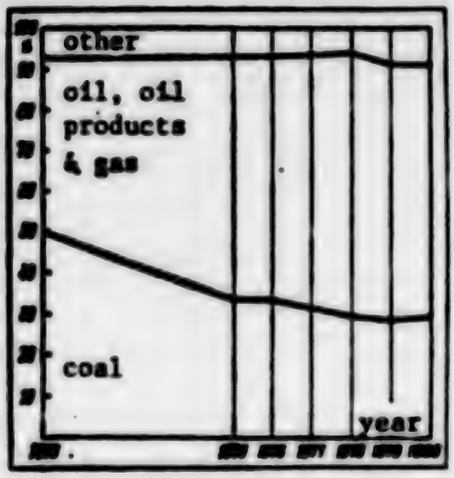


Fig. 4. Structure of energy resources in Hungary (1970-1980)

In satisfying national economic requirements on a basis of a suitable production structure and with the complete utilization of the opportunities which the energy program provides, our aim is that the annual increase in the consumption of energy resources in the national economy should not exceed 2 percent in the following period.

Annual energy consumption must rise from the 1,260 PJ in 1980 to a maximum of 1,400 PJ by 1985.

For carrying out such a task, the plan is to employ 50 percent local energy resources and 50 percent imported ones (Fig. 3). The energy resource structure shows a decline in the share of oil, oil products and natural gas and increasing participation of nuclear fuel and other resources (Fig. 4 and Table 2).

Table 2

	1980	1985
Coal, %	29.2	27.0
Oil, oil products, natural gas, %	62.2	58.0
Nuclear fuel, %	--	5.0
Others, %	8.6	10.0
Total, %	100.0	100.0

The basic amount of coal (80 percent) will come from mining in the nation and this will remain on the same level or will increase slightly. Planned mine construction is being carried out at the new deposits of Markushed and Nagyedhaza producing coal from the Eocene Age with operations expected to start in 1981.

In order to satisfy the demand for high quality brown coal, rapid construction is to be carried out on two other mines--Man and Lencehed II. These mines will go into operation a year before the planned date (1984-1985) and this will compensate for the decline in output at the operating mines and will ensure regular supply for consumers (chiefly the public) with high grade brown coal.

The relative share of oil, oil products and natural gas is to decline. Annual oil refining which was 9.5 million tons in 1980 will not change up to 1985. The satisfying of the insignificantly increasing gasoline requirements will be provided by increasing refinery capacity.

In the second half of the planned period, there are plans to build a catalytic cracking installation with an annual productivity of 1 million tons.

Natural gas consumption, without a change in imports and with an insignificant increase in local production (0.5 Gm^3 per annum of highly inert gas) will change insignificantly in comparison with 1980.

The most important task of the oil and gas industry is to increase the effectiveness of research and production in order to compensate for the reduced capacity and to ensure annual production of 2 million tons of oil and 6-6.5 Gm^3 of natural gas.

A particularly important economic problem is the starting up of the first stage of the Paks AETs with a capacity of 1,760 megawatts. By the end of the 5-year period this plant will satisfy 5 percent of the national economy's energy needs (20 percent of the total electric power consumption).

In order to more fully satisfy the energy requirements, there are plans to increase the importing of electric power. This will be carried out by Hungary's participation in the joint construction of the Khmel'nitskiy AETs and the 750-kilovolt power transmission line [PTL] between Khmel'nitskiy and Rzeszow.

A new area for increasing the nation's energy resources is the increased use of waste energy in agriculture and industry as well as geothermal energy.

In order to more fully utilize the local energy sources and carry out the comprehensive tasks of energy policy of particular importance is the carrying out of the coal mining development plan (the so-called "Eocene" program).

It provides the following:

1) The new Eocene mines will provide an opportunity to build a new electric plant operating on local coals (the Bicke TETs), they will replace the depleted deposits in the Tatabanya coal basin as well as satisfy the needs of consumers for high quality brown coals at present and in the future;

2) The building of new mines with the deep operation of the seams will provide an opportunity to employ the released labor force from the old mines;

3) With the suitable placement of the coal mines for deep mining of the seams opportunities will be created for exploiting the bauxite deposits in these basins;

4) Opportunities are provided to create new coal-based technologies and this will reduce the need for oil.

The Energy Program of the Sixth Five-Year Plan

With the change in the domestic and foreign conditions for the supply of energy to the national economy, the decline in energy consumption becomes one of the basic tasks in the nation's economic policy. For this reason the Council of Ministers has established a program for carrying out the energy system tasks in the 1981-1985 period.

The energy program contains specific tasks in all areas of the economy to carry out the tasks of the Sixth Five-Year Plan. The program will provide the organizational conditions and material-technical means for implementing them. The state management bodies, the enterprises as well as the entire population have a major role in carrying it out.

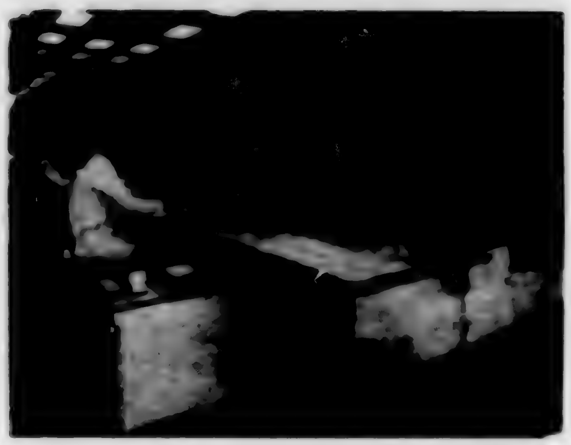
The successful fulfillment of the program will be aided by the following: Technical development, efficient use of scientific and technical achievements, the consistent application of the established price policy for energy resources, the state subsidies, easy credit terms and certain other measures.

For carrying out the more efficient energy policy, all enterprises must implement the following activities:

1) Constantly analyze energy losses;

2) Elaborate indicators for energy consumption per unit of product which would be compared with analogous indicators in other countries;

3) Test out the production methods from the viewpoint of their energy intensiveness and introduce new production processes with a lower specific energy consumption or more acceptable ones from the national economic viewpoint;



The National Dispatching Control Room

4) Constantly check the equipment and automation as well as the production facilities in the production which consumes or processes large amounts of energy;

5) Constantly improve the efficiency and state of the local power supply systems (steam, hot water, compressed air, electric power) and so forth;

6) Seek out solutions for general and local power supply with a higher efficiency and lower cost;

7) Work out and introduce rationalization proposals in the area of energy supply and utilization;

8) Enterprises with high energy consumption are to work out annual plans for saving energy.

In assessing the work and paying bonuses to enterprise leaders, it is essential to bear in mind the level of the energy system in the enterprises managed by them.

Help must be provided to enterprises which produce equipment with improved efficiency, attachments and materials needed for increasing the technical level of power engineering and increasing energy savings. Such enterprises must receive central funds for technical development by granting credits for capital investments going into the rational use of energy, on the basis of prices and price formation in accord with the prescribed indicators and materials.

The program has elaborated detailed measures to save energy and for rationalization of the national economy during the Sixth Five-Year Plan, the conditions for fulfilling them and the responsible executors.

In addition to solving specific problems, the carrying out of the energy program is aimed at making all Hungarian citizens personally interested and responsible for energy savings and at putting the question on a broad social basis. The propaganda possibilities of the press, radio and television are to be evermore actively used for this purpose.

CUBAN POWER CONSTRUCTION PLANS TRACED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 27-28

[Article by Jose Beltran, first deputy minister of basic industry in the republic of Cuba and leader of the Cuban delegation to the CEMA Permanent Commission for Cooperation in the Power Engineering Area: "Prospects of Cuban Energy Construction"]

[Text] Prior to 1958, electric power in Cuba was in the hands of small national enterprises and American Foreign Power under whose control was the incorrectly named Cuban Electricity Company.

Only those cities were electrified which brought sufficient income as well as industry, trade the the property owned by the monopolies which controlled the nation's economy.

The 1959 Cuban Revolution and the profound political, economic and social changes which it caused marked the beginning to the unprecedented development of power engineering.

In spite of the economic blockade which the United States imposed, Cuba began to develop rapidly in a continuous struggle to eliminate backwardness and build up socialism under the banner of the Marxist-Leninist ideology. The basis for the attaining of these goals was the support provided by the socialist countries and primarily the USSR which provided exceptionally great aid for the nation's economic development.

The efforts to develop electric power have been particularly great. Here we have introduced equipment produced in the socialist countries and adapted to the 60-hertz operating frequency of the electric networks in Cuba.

The results are illustrated by data showing the state of the power systems in 1958 and 1980:

	1959	1980
Installed capacity, Mw	397.1	2212.1
220-kilovolt power transmission lines, km	--	1212
110-kilovolt power transmission lines, km	298	2186.5

In 1959 the nation's production of electric power was 1,750 Gwh and in 1980, 8,855.5 Gwh.

This growth was caused by the development of a number of economic and social spheres such as industry and agriculture, the construction of housing, schools, hospitals and so forth as well as by the broad development of electrification in the agricultural regions. This commenced immediately after the victory of the revolution in order to reduce the difference in living conditions in the city and countryside.

After 1970, there has been a turn to a higher voltage in order to ensure dependable energy transmission in the nation. In 1980, the decision of the First Party Congress was carried out to build a unified national electric power system operating on 220 kilovolts.

Thousands of kilometers of power transmission lines have been built for 34.5 kilovolts and lower voltage to ensure electricity supply to consumers. In 1980, the annual per capita electric power production reached 1,020 kilowatt hours.

Prior to the victory of the revolution, specific fuel consumption at the power plants in the nation was 396 grams per kilowatt hour, while at present it is 280 grams per kilowatt hour. This is of enormous significance for the nation as it does not possess enough of its own power resources and satisfies its needs mainly by imports.

Open-air 220-kilovolt distributor facility

The Carlos M. de Seispedes TETs in Cienfuegos
built with Czechoslovak aid

Development Prospects of Electric Power Engineering in the Near Future

In viewing the prospects of the 1981-1985 Five-Year Plan, in the Basic Report of the Second Party Congress, Comrade Fidel Castro said: "...Electric power production will rise by more than 50 percent, in planning to put 1,000-1,200 Mw of capacity into operation. At the same time an AETs will be built in the area of Juragua and a central pumping-storage hydropower plant [PAVETs]...."

During this period further construction will be carried out on the 220-kilovolt network to ensure power supply to the most important industrial facilities in the northern and eastern parts of the nation.

There are plans to build a network with a voltage of 400-500 kilovolts to ensure the transmission of power from the large units of the Juragua AETs.

By 1985, we expect the maximum load to reach 2,500 Mw. The new plants and factories which will be built in the nation will have the greatest impact on the increase. In addition to this, in parallel with the development of industry, electrification of agriculture and an increase in household electrical appliances will be continued.

The development targets up to the year 2000 are based on cooperation, economic integration and progression changes in the national economic structure toward a more rational production structure guaranteeing the maintaining of high and steady development rates. Their aim is to continuously bring Cuba closer to the development level of the other European CEMA countries.

220-kilovolt power transmission line
built with Soviet assistance

The development of power engineering in Cuba is aimed at the construction of nuclear power plants, the first of which will be equipped with reactors of the VVER-440 type.

In the 1986-1990 period, there are plans to build a PAVETs which will be constructed in the central part of the nation, while in the western and eastern part studies will be made on constructing other PAVETs up to the year 2000.

The 25th anniversary is being celebrated of the founding of the Permanent CEMA Commission for Cooperation in the Power Engineering Area. This is an event which is being celebrated in Bulgaria.

Cuba is a comparatively new member of the Permanent Commission but it can already be said that its participation has had a positive effect on the nation's power engineering. It must be emphasized that our nation will make a maximum effort to the best work of the commission so that the fruits of socialist economic integration become ever greater.

10272
CSO: 2200/112

RAPID DEVELOPMENT OF MONGOLIAN FUELS AND POWER INDUSTRY VIEWED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 30-33

[Article by Sodovin Batkhuyag, deputy minister of the Mongolian fuel and energy industry and leader of the Mongolian delegation to the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "The More Rapid Development Pace of the Fuel and Energy Base in Mongolia"]

[Text] Prior to the victory of the people's revolution in 1921, Bulgaria was one of the most backward nations in the world. The population knew no other source of energy but the muscle power of animals and man and no other means of lighting except the open fire. Mongolian power engineering began to develop under exceptionally different conditions with a lack of industry and skilled workers, engineers and technicians. The nation was sparsely populated and illiteracy prevailed among the population.

Only the consistent carrying out of Lenin's teachings about the role of electrification in the development of the national economy by the Mongolian People's Revolutionary Party [MPRP] and the Mongolian government and the fraternal aid from the USSR and the other socialist countries provided an opportunity for Mongolia to overcome the difficulties inherited from the prerevolutionary past and create its own fuel and energy base.

The development of the Mongolian energy industry can be divided into three basic stages differing both in terms of the scale of growth and the technical development.

The first stage encompasses the period from the start of the 1920's to the end of the 1930's. In 1921-1922, the first diesel and locomobile electric plants with a capacity, respectively, of 24 and 60 kilowatts were put into operation in the capital city of Hureye (now Ulan Bator) predominantly for the purpose of creating electric light. From 1931, the first industrial enterprises which were comparatively large for those times began to be built. In 1934, Ulan Bator began operating an industrial combine built with Soviet aid including several factories for processing products from livestock raising. At this combine was built the first TETs with a capacity of 2.5 megawatts. Designed initially only for supplying the industrial combine with energy, this TETs later was used to satisfy the rapidly growing municipal and domestic needs of the city. For this reason its capacity was very quickly exhausted and it had to be repeatedly enlarged. In 1938, its power rose to 5 megawatts. During this period not only individual industrial sectors began to gradually form but also there was the turning of industry into an independent national economic sector.

The second stage includes the period from the start of the 1940's to the beginning of the 1960's. After 1940 and particularly during the years of the first five-year plans (1948-1957), such important industrial sectors developed rapidly as mining, the production of building materials, printing, the light and food industries. Metalworking enterprises were also created.

The establishing of the foundations of a multisector socialist economy required a thorough revision of the fuel and energy base. During these years significant work was done to reconstruct the old coal deposits and develop new ones. Close to Ulan Bator, at the Naylaha deposit, a second, more advanced, highly mechanized mine was developed with a productivity of 600,000 tons of coal annually. Coal mining enterprises with low productivity were also opened in many aymaks.[1] As a result of this, coal mining in 1960 had increased by 3.6-fold in comparison with 1940.

The electric power base was also significantly strengthened. As a result of repeated expansion, the capacity of the pioneer of power engineering, the TETs No 1 in Ulan Bator, reached 24 megawatts.

Along with improving power supply, significant measures were carried out to electrify the rural areas and the aymak centers. During the years of the First Five-Year Plan power plants were built in six aymak centers and by the end of the 1950's in all the aymak centers. As a result of this construction, total electric power production in 1960 rose by more than 5-fold in comparison with 1950 while per capita production had increased 4-fold.

For Mongolia, the electrification of rural areas has been and remains the most difficult problem. The enormous territory and the remoteness of the small world consumers hundreds of kilometers apart greatly complicate the electrifying of everyday life and agricultural production. In this stage in the rural areas there began to spontaneously appear small mobile power plants with a capacity of several-score kilowatts operating on liquid fuel. At their prime they played a positive role in providing an opportunity to mechanize the most labor-intensive processes and to satisfy the elementary municipal and household needs, most importantly electric lighting.

---

[1] An aymak is an administrative-territorial unit set up considering the economic features of a given area. Mongolia presently has 18 aymaks.

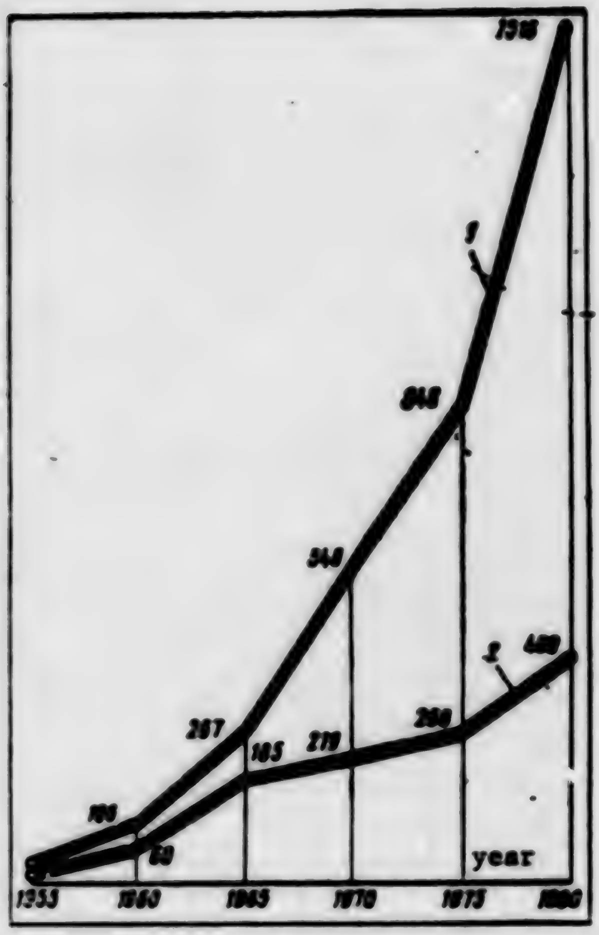


Fig. 1. Increase in electric power output and installed capacity of power plants

1--Electric power output, million kilowatt hours; 2--Installed capacity, 1,000 kilowatts.

Simultaneously with the construction of the first TETs in Ulan Bator, the electrical network and central heating system of the city began to be built. During the first period a network with a voltage of 2,000 volts was used for distributing the electric power, and later, after the expansion of the TETs No 1, the network was rebuilt for 6,000 volts. In line with the expansion of the Naylaha Mine in 1939, the highest voltage in the network of Ulan Bator reached 35 kilovolts.

The third stage encompasses the period from the start of the 1960's up to the present.

From the start of the 1960's, Mongolia began a new stage in its socioeconomic development, the stage of completing the material and technical base of socialism.

Considering the leading role of power engineering in creating the material and technical base of socialism, the 14th MNRP Congress held in 1961 adopted a historic decision to provide more rapid development of the fuel and energy industry. Later, in the Fourth MNRP Program approved by the 15th Congress in 1966, this decision was declared to be a program task for our party.

As a result of successfully carrying out the Third Five-Year Plan for national economic and cultural development (1961-1965), the nation's energy base was significantly strengthened. In this five-year plan, the Darhan Industrial Complex was created and this included a TETs with an installed capacity of 48 megawatts.

In addition to this, in Ulan Bator, the TETs No 2 was put into operation with a capacity of 12 megawatts and the expansion of the TETs No 1 was completed by which its capacity rose to 36 megawatts. In the towns of Tosontsengel and Ulgiy, small TETs were built with a capacity from 1.5 to 3 megawatts. In this manner, in 1965, the installed capacity of the power plants and the produced electric power rose, respectively, by 2.9- and 2.4-fold, in comparison with 1960. During these years the fuel and energy industry developed finally as an independent sector.

The creation and development of a national fuel and energy industry was based and continues to be based on the selfless aid of the USSR. This aid was expressed in the building of power plants, transmission lines and substations with personnel and equipment from the USSR, the exploitation of coal mines and the delivery of coal mining, energy and electrical engineering equipment and materials.

During the years of the Fourth and Fifth Five-Year plans (1966-1975), the strengthening of the nation economy's energy base and the improving of electric supply contined.

In Ulan Bator a new TETs was built with a capacity of 48 megawatts and in Choybalsan, located in the east of the nation, a TETs with 12-megawatt capacity was put into operation. In the aymak centers, the numerous mobile diesel plants were replaced by larger stationary diesel units and this significantly increased the reliability of electric supply.

As a result of these quantitative and qualitative changes, Bulgaria has become among the 10 best energy-supplied nations of Asia and surpasses the nations of the Near and Far East and Africa in terms of the average values of such important indicators as the per capita consumption of energy resources and electric power and installed capacity of the power plants per 1,000 inhabitants (Table 1). It must be pointed out that in the 1950's, for these indicators Bulgaria was on the average or below the average level of these countries.

Table 1

Countries	1 Потребление на енергийни ресурси на човек от населението, kg у.г.				2 Потребление на електроенергия на човек от населението, kWh				3 Инсталирана мощност на 1000 души, kW			
	1950	1960	1970	1974	1950	1960	1970	1974	1950	1960	1970	1974
Mongolia	122	540	888	1046	29	111	413	528	—	64	175	179
Far Eastern	130	238	498	552	76	166	423	513	19	37	91	123
Near Eastern	147	340	804	1023	32	98	315	434	12	33	86	113
African	189	254	309	359	74	146	247	309	18	39	67	75

Key: 1--Per capita consumption of energy resources, kg of fuel units; 2--Per capita consumption of electric power, Kw hours; 3--Installed capacity per 1,000 inhabitants, Kw.

During this period, however, the most significant achievement was the creation of the first energy system in the central economic region of the country. The system formed by connecting the 110-kilovolt power lines from the power plants in Suhe Bator, Darhan and Ulan Bator not only increased the dependability of electric supply in these industrial centers but also helped improve the supply of electric power to agricultural consumers in this area by connecting them to the power system.

During the 1976-1980 period, major quantitative and qualitative changes occurred in the nation's power engineering. Almost 2-fold more electric capacity went on stream than in the previous decade (Fig. 2). During this five-year plan, our power engineering converted to high-parameter equipment. For the first time since the victory of the people's revolution, the nation produced 1 billion kilowatt hours of electric power in 1977. It took a little more than 5 years to produce the second billion, and just 3 years for the third. Such are the development rates of Mongolia. Our party's decisions to ensure the more rapid development of power engineering are being successfully carried out (Table 2).

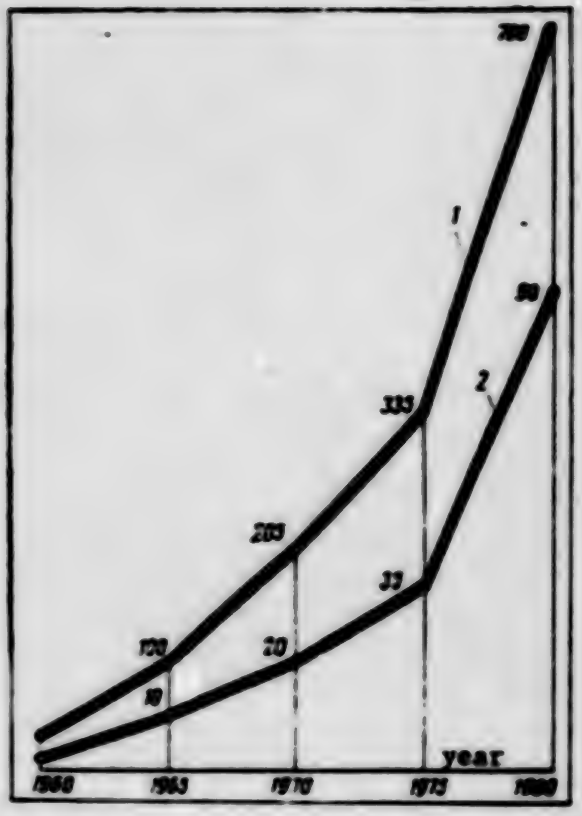


Fig. 2. Electric power consumption in individual national economic sectors, million kilowatt hours

1--Industry; 2--Agriculture

With the connecting of the Mongolian power system in 1976 to parallel operations with the powerful Siberian Power System of the USSR over a 220-kilovolt power transmission line, a new page was opened in the history of cooperation between the Soviet and Mongolian power engineers. As a result of this link, our power system became part of the power systems of the socialist commonwealth which at present covers the vast territory from Ulan Bator in the east to Berlin in the west. This reaffirms the instructions of V. I. Lenin that "...modern progressive technology urgently demands the electrification of our nation and neighboring nations following a single plan."

The parallel operation with the Siberian United Power System provides an opportunity to substantially reduce reserve capacity in our power system and provide dependable supply of electric power to the most important industrial installations and adjacent rural consumers. This line of development is an essential prerequisite not only for significantly increasing the efficiency of our TETs but also plays a major role in selecting and developing the high-power thermal power equipment operating on high steam parameters.

The basis of power engineering in Mongolia is thermal power plants with combined production of electric power and heat. Their capacity by 1 December 1980 was over 410 megawatts, representing 67 percent of the entire installed power capacity while the 1,302,200 kilowatt hours produced by them were 85.9 percent of all the energy produced in the nation.

Table 2

Ratio Between Rates at Which Electric Power Generation and Total Industrial Production Develop

Period / Indicator	1960-65	1966-70	1971-75	1976-80
Annual average increase in gross product of all industry	9.8	9.9	9.2	9.4
Average annual increase of electric power product	22.2	18.9	10.2	12.3
Lead factor of electric power engineering	2.265	1.909	1.108	1.292

The remaining 33 percent of the installed capacity and 14.1 percent of the produced electric power come from diesel power plants operating on imported fuel. At present 14 of all 18 aymaks obtain electric power from these plants. The aymak centers have stationary diesel units with a unit capacity of 600-800 kilowatts while the agricultural associations, state farms and their subdivisions and farms use numerous low-power diesel plants.

Hundreds of kilometers of transmission lines of varying voltage and many substations and bus- and -switch installations have been built for the transmission and distribution of the electric power. At present the nation has built and has in regular operation over 11,000 km of transmission lines of which 10.7 are high voltage, over 35 kilovolts. The total installed capacity of the power transformers is over 1,017 megawatts.

In the major cities such as Ulan Bator, Darhan and Choybalsan, heat supply is centralized with a high degree of centralization, some 85-90 percent.

Significant changes have occurred in the consumption structure of electric power. While in 1930 virtually all the produced electric power was consumed for municipal and household requirements, at present a large portion of the electric power goes to satisfy the needs of such basic national economic sectors as industry and agriculture.

Mongolian power engineering has developed chiefly by the maximum utiliazation of its own energy resources, primarily the high grade brown and cherry coal. On the nation's territory at present 160 deposits have been discovered and their reserves have been estimated at 16.5 billion tons, including around 10 billion tons suitable for strip mining.

The largest coal mining enterprises are the Sharingol strip mine and the Nalayha-Capital mine; these are located in the central economic region and have an annual production, respectively, of 2 and 1 million tons.

At present power engineering is one of the technically most advanced sectors of the national economy. This sector disposes of 10.6 percent of the fixed industrial capital, it employs 7.4 percent of the personnel employed in industry and they produce over 10 percent of the gross industrial product.

During the years of communist power, highly skilled personnel have been developed including workers, white collar personnel, engineer and technical specialists who are solving the questions of the efficient operation of the highly productive equipment and managing the national energy system. The USSR and the fraternal socialist countries have provided us with invaluable aid in the training of our engineers and technicians.

In the Seventh Five-Year Plan (1980-1985) further measures will be taken to strengthen the nation's energy base. The largest TETs will be built in Ulan Bator and its turbines will have a unit capacity of 80-110 megawatts. Preliminary design work will be completed for the construction of the Baganur TETs with 200-megawatt units.

In order to carry out the decisions of the 18th MPRP Congress to develop power engineering and ensure the dynamic development of the national economy, the Mongolian power workers are focusing their efforts on solving the following problems:

1) Maximum use of the national energy resources, primarily the brown and hard coals, by increasing the efficiency of the existing fuel and energy enterprises, by opening up new strip mines with production of 2-4 million tons a year in promising coal deposits as well as by building large thermal power plants and high-voltage transmission lines;

2) Increasing the technical level of the sector by utilizing modern highly productive equipment and introducing efficient production schemes;

3) Carrying out close cooperation with the USSR and the other fraternal CEMA countries in carrying out socialist economic integration measures involving a solution to energy problems.

The successful solving of these questions is an indispensable condition for carrying out the set tasks in developing and strengthening the energy base and satisfying the rapidly growing needs of the national economy for fuel and energy.

10272
CSO: 2200/112

ROLE OF POLISH THERMAL POWER CAPACITY DESCRIBED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 35-38

[Article by Zbigniew Bartosiewicz, Polish minister of power industry and atomic energy and leader of the Polish delegation to the CEMA Permanent Commission for Cooperation in the Power Engineering Area: "Thermal Electric Generating Capacity--The Basis of the Polish Power Industry"]

[Text] Main Directions in the Development of the Polish Power Industry in the Past Period

The rapid development of Poland since World War II has caused a rise in the demand for electric power both in industry as well as in the municipal and household sector. The complete electrification of agriculture and rail transport have also contributed to the greater demand for electric power.

During the 1946-1979 period, electric power production increased from 5.2 to 117.4 billion kilowatt hours, that is, by 22.5-fold, while the capacity of the power plants rose from 2,350 to 24,785 megawatts, that is, by 10.5-fold. This bespeaks the significant increase in the intensity of installed capacity at the power plants. During this period obsolete units were taken out of operation with a total capacity of 2,000 megawatts. It can be asserted with confidence that the Polish power industry was created after the war.

From an analysis of the increased demand for electric power, it can be seen that in the postwar period, up to 1958, this doubled in 6-7 years, up to 1975 in 8-9 years, and in recent years in more than 10 years. This decline in the annual increase of electric consumption can be observed in all nations with a simultaneous rise in their industrial potential and the conversion to more advanced technology in the national economy and an improvement in services.

Along with the increase in production capacity, extensive construction of electric networks has been carried out on all voltage levels. The expansion of the 210-, 220- and 400-kilovolt networks has created the prerequisite to connect all the energy sources in parallel operation and create a united power system in the nation.

The development of the network system has been characterized by a constant rise in the voltage level in the transmission lines. The first 220-kilovolt power lines were built in 1947, and those of 400 kilovolts in 1962. The 110-kilovolt power lines which were the basic carriers immediately after the war at present are being converted to the distribution network. The completion of high-capacity power plants has meant the intensive development of the 400-kilovolt network. In planning the development of the Polish energy system, consideration has been given to the growing tendency to unify the power systems of the individual nations. Several 220-kilovolt power lines and six 400-kilovolt ones link the Polish power system with the systems of the neighboring countries. In addition, Poland is a member of the United Power Systems (UPS) of the CEMA nations and these possess an installed capacity of 90,000 megawatts. In the UPS of the CEMA nations, Europe's first (not including the USSR) 750-kilovolt power transmission line has been built between Vinnitsa (USSR) and Albertirsa (Hungary).

In accord with the nature of the nation's power resources, the construction of new power plants in Poland has been focused mainly on the TETs operating on bituminous and brown coals. For this reason the scientific and design potential has been concentrated on elaborating the technical solutions for designing, building and operating coal-fired power plants and expanding technical progress in this area. During the first postwar years, power engineering design institutes and major enterprises were founded for producing steam generators, turbines, generators, transformers, electric motors, communications electrical equipment, high-pressure steam and water equipment as well as auxiliary equipment.

Using foreign licenses, specialists from the design bases in the nation developed a series of turbines with a power of 25-30, 50, 125 and 200 megawatts with the steam generators for them. Steam generators were also developed for 500-megawatt power units. Recently units have been put into production with a capacity of 360 megawatts and operating on bituminous and brown coals.

Of great significance for centralized heat supply was the introduction of the heat generating units with an electric capacity of 50 and 100 megawatts of the BS-50 and BS-100 types which were used for a number of years by the public TETs.

A certain, small portion of the equipment was delivered by imports, predominantly from the USSR.

Due to the policy carried out in the energy area, a high level of standardization was achieved in equipping the power plants. For example, a series was produced of 24 units of 125 megawatts each and a series of 63 units of 200 megawatts. The 125-megawatt units were removed from production in 1970. At present the production of the 200-megawatt units is being stopped. Two 500-megawatt units are operating with good indicators at the Kozienice TETs. We are in the process of introducing a new series of units of 360 megawatts each.

The following more important projects can provide a notion of Polish energy construction at the present stage:

The Torow TETs with a capacity of 2,000 megawatts using 200-megawatt units operating on brown coals with a combustion heat of 7,540 kJ/kg. The power plant was put into operation in 1962. It is marked by high reliability. The annual use factor for installed capacity has reached 7,200 hours;

The Pientnow TETs with a capacity of 1,600 megawatts and 200-megawatt units, six of which operate on brown coal with a combustion heat of 1,400 kJ/kg and two on mazut. A natural lake is incorporated in the cooling system;

The Lower Odra TETs with a capacity of 1,600 megawatts and units of 200 megawatts each operating on coal with a combustion heat of 21,000 kJ/kg and an open cooling system which uses water from the Odra River;

The Rybnik TETs with a capacity of 1,600 megawatts and 200-megawatt units operating on slurry and seams removed in the coal dressing. A combined cooling system is used with a man-made reservoir and cooling towers;

The Kozienice TETs with a capacity of 2,600 megawatts and eight units of 200 megawatts each and two units of 500 megawatts operating on coal with a combustion heat of 20,000 kJ/kg. The cooling system is open with cooling towers being used during heat spells;

The Rzeran TETs put into operation in 1952 with an electric capacity of 250 megawatts and a heating capacity of 1,470 megawatts;

The Siekierki TETs put into operation in 1961 with an electric capacity of 620 megawatts and a heating capacity of 2,520 megawatts. Along with the Rzeran TETs and other centralized heat supply sources, this is a basic element in the large central heating system of Warsaw which heats and supplies hot water to over 85 percent of the constructed housing volume and industrial enterprises in the city.

Basic Directions for the 1985-1990 Period

The Power Institute under the Ministry of the Power Industry and Atomic Energy is concerned with forecasting electric consumption growth related to the nation's socioeconomic development and primarily to the growth of national income. In the analyses and forecasts, electric power plays a primary role as a fine energy source which satisfies the needs of the national economy along with the other major energy sources such as gas, liquid fuel, coke as well as steam and hot water from the central boilers and thermal plants. It must be emphasized that in Poland the central gas and heat supply of the cities has been well developed and this will significantly slow down the growth rate of electric power consumption. Analyses indicate that electric power generation will rise from 122 billion kilowatt hours in 1980 to 155 billion kilowatt hours in 1985, and this corresponds to an annual increase of 4.9 percent. In the consumption structure, the municipal-household, agricultural and food sector will outstrip industry.

In determining the directions for energy development, the basic problem for each nation is to find the economically justified base for energy resources. Up to the present coal has been such a base for Polish power and will remain so in the future.

Bituminous Coal

The Upper Silesia deposits will continue to be the basic source of bituminous coals. From the economic viewpoint, of great interest are the coking coal deposits in the Rybnik Coal Deposit where coal mining in the last decade has developed particularly rapidly. The Lublin Coal Basin located in the eastern part of the nation has been assuming great significance, and due to this the geological bituminous coal reserves in Poland have been increased by around 30 percent. In following years the first quantities of coal will be received from the coal mining capacity built in this basin. The significant coal reserves of this deposit will provide an opportunity to forecast an increase in mining from 193 million tons in 1980 to 220 million tons in 1990. The portion of coal earmarked for energy production will not increase proportionately due to the demand of the domestic market for heating coal and the foreign trade obligations. This seriously restricts the possibilities for building new coal-fired electric plants.

Model of the Bielhatow-1 TETs

At present at the operating Polanec TETs the capacity of which in 1982 will reach 1,600 megawatts they are installing 200-megawatt units. There are plans to continue the expansion of this plant. Construction is progressing at the Opole TETs with six 360-megawatt units. Its completion is planned for the 1984-1989 period. According to the forecasts, this is the maximum capacity for expanding the electric plants operating on coals from the Upper Silesia Basin. The possibility is being studied of building a power plant of 3,000 megawatt capacity operating on the Lublin Coal Basin.

An important area for the rational utilization of bituminous coal is the use of residual product obtained in coal processing at power plants built specially for this purpose. In recent decades there has been extensive application of the technology of producing a mix of coal and residual products used as fuel in the power plants.

Brown Coal

The other basic source for increasing electric production is the brown coals with a combustion heat of around 8,400 kJ/kg. The significant reserves suitable for strip mining provide an opportunity to increase their annual output from 37 million tons at present to around 85 million tons in 1990 and over 130 million tons in the year 2000. As the transporting of the coal is unprofitable, the power plants will be built close to the deposit and to a significant degree this will determine the configuration of the power transmission networks.

The capacity of the existing power plants fired by brown coal at present is 4,400 megawatts, that is, over 20 percent of the installed capacity of the public power plants. The power plant in Bielhatow is being built rapidly and this has a designed capacity of 4,320 megawatts consisting of 12 360-megawatt units. We plan to have the first unit in operation this year and designed capacity will be reached in 1987. The construction potential of the Bielhatow energy complex can be used for opening up the nearby Szczercow Deposit and for building a power plant with a capacity of around 1,500 megawatts.

During the 1983-1984 period, there are plans to put into service two new 360-megawatt units at the Torow power plant and this will increase its capacity to 2,720 megawatts.

In the long run there are plans to use the significant brown coal deposits in Lower Silesia for energy purposes.

Hydropower Engineering

At present the hydropower plants [VETs] produce 3 billion kilowatt hours annually, of which 1.9 billion kilowatt hours are from natural hydropower resources and the remainder from pumping-storage plants [PAVETs].

The future economically justified hydropower resources of the nation are comparatively limited. They are around 12 billion kilowatt hours. On a local scale and with the integrated solution of water management problems, of great significance is the already completed construction of hydropower works on the upper and lower course of the Vistula River as well as the VETs with regulated reservoirs built in the piedmont areas of rivers. The carrying out of the program to convert the Vistula River into a navigable river along its entire length with the building of a series of VETs will provide an opportunity to increase the capacity of these power plants to around 2,100 megawatts and will increase the utilization of the hydropower resources more than 70 percent.

We are in the process of carrying out a program of PAVETs construction with a maximum consideration of the topographic and geographic conditions. These plants will increase the flexibility of the power system. They will employ the pump-turbine generally recognized as the most economic units and already in operation at the

Zidovo PAVETs with a capacity of 150 megawatts, the Porombka-Zar PAVETs with a capacity of 500 megawatts and are also in the last stage of installation at the Zarnowec PAVETs with a capacity of 680 megawatts. The Mloti PAVETs with a capacity of 750 megawatts will also be built with reversing units.

Nuclear Power Plants

As was emphasized, up to the year 2000 a significant increase is planned in the output of bituminous and brown coals. This means that our own solid fuel base will be maximally developed from the viewpoint of the available reserves and the possibilities of their industrial development. The oil and natural gas reserves are insignificant and cannot be considered in forecasting the energy resources.

Under these conditions, in order to coordinate the nation's energy balance, it is essential to develop nuclear engineering. A start will be made with the building of the first AETs in Zernowce, in the middle of the nation in 1987. Intensive construction will also be continued at other AETs. The achieved agreements in the area of cooperation envisage that up to 1990 equipment will be imported for completing AETs with a total capacity of around 5,900 megawatts. The development of nuclear engineering up to the year 2000 must ensure an annual increase in installed capacity of 1,500-2,000 megawatts.

The rapid development of centralized heating supply with an annual increase of 6.5 percent requires starting construction of AETs and nuclear central heating plants with a high heat capacity. It is planned that this will be carried out after 1990.

Poland is participating in cooperation under CEMA in producing equipment for the AETs. In the agreement signed in 1979 for multilateral international production specialization and cooperation and mutual equipment deliveries for the AETs, in the 1981-1990 period Poland has been assigned a significant production program for AETs equipment and the amount of equipment and nuclear fuel which will be imported from other states have been set. Within the agreed upon specialization, Polish industry will produce the following AETs equipment: steam generators, pressure stabilizers in the heat exchangers, 500-megawatt turbines, internal combustion engines for safety needs, monitoring and metering equipment and containers for the transporting of nuclear fuel. The Polish scientific research institutes and organizations, in cooperation with similar institutes and organizations in the other CEMA countries, will participate in solving the most important problems in the development of nuclear engineering such as developing units of the VVER-1000 type, large-capacity fast-neutron reactors and heat supply nuclear power plants.

Power Transmission Networks

An analysis of further development for the Polish power transmission network shows that in the immediate future it is not advisable to use voltage above 400 kilovolts in transmitting electric power in the nation. The use of 750 kilovolts at present can be justified only by the necessity of providing intersystem links for transmitting large capacity over great distances.

The expansion of the parallel operation of the CEMA power systems has a significant impact on the development of the Polish power system. One of the specific results of cooperation within CEMA was the General Agreement signed in 1979 on cooperation among the involved CEMA members in building the Khmel'nitskaya AETs with a capacity of 4,000 megawatts on Soviet territory. On the basis of this agreement, Poland will receive as its share in building the plant a total of 1,000 megawatts of capacity and 6 billion kilowatt hours of electric power. Deliveries will begin in 1984 and the quantities will gradually be increased.

At the same time an agreement has been concluded on cooperation in the construction and operation of a 750-kilovolt power line which will link the Khmel'nitskaya AETs (USSR) with Rzeszow (Poland) and the Rzeszow Substation; this is to be completed in 1983. This power line will ensure the importing of electric power from the USSR into Poland as well as its transit transmission from the Polish power network to the CSSR and Hungary. Thus the opportunity will be increased for the United Power Systems of the CEMA countries to utilize capacity reserves and the intersystem effect from the differing time of the peak load.

The programs for the operation of the Polish power system are coordinated with the programs and forecasts, the international power exchange and emergency aid within the United Power Systems of the CEMA countries by the Central Dispatching Administration headquartered in the capital of the CSSR, Prague.

10272
CSO: 2200/112

DEVELOPMENT OF POWER SOURCES IN ROMANIAN INDUSTRIAL PLANS

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 40-44

[Article by Trandafir Cocirla, Romanian minister of electric power and leader of the Romanian delegation to the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "The Building of the Power Base--The Basis for the Economic Ascent of Romania"]

[Text] The antifascist and antiimperialist revolution for national and social liberation of August 1944 and the assuming of power by the working class under the leadership of the Romanian Communist Party [RCP] created the conditions for the rapid and planned development of the entire national economy. Within the extensive program elaborated and implemented steadily by the RCP for reconstruction and development, particular attention has been given to the power industry as one of the sectors of particularly important significance for all the economic and social activities of our nation.

As a result of the successful carrying out of the economic and social development plans, production of electric power over the last 30 years has increased by 32-fold. There has been corresponding development of equipment for the production, transmission and distribution of electric power within the Joint National Power System. At the present stage, the Romanian energy workers are taking an active part in carrying out the directives of the 12th RCP Congress for the further development of the power base. These envisage the fuller use of all the national energy resources, including the low-grade ones such as the low-calorific lignites and bituminous shales as well as the low hydropower potential and new energy sources.

There is also to be a further improvement in the organization and operation of the national power system as well as the application of strict economy of fuel and electric power in all sectors and areas of social activities. The report given by the General Secretary of the RCP and President of the nation, Comrade Nicolae Ceausescu, at the 12th Party Congress emphasized that the growth of the national power base is the basic area in the development of both industry and the entire national economy during this five-year plan.

The Evolution in the Consumption and Production of Electric Power

In 1950, when the industrialization of the nation was beginning, the per capita electric power consumption was 128 kilowatt hours. In 1960, this indicator was 414 kilowatt hours, in 1970, 1,614 kilowatt hours, and in 1980, exceeded 3,000 kilowatt hours, corresponding to a total electric power output of 67.5 billion kilowatt hours (Fig. 1). However, it must be pointed out that during the last five-year plans, the average growth rate of consumption has gradually declined as a result of the more rational use of electric power. In comparison with the average annual increase in consumption of 15.7 percent achieved during the 1961-1970 period, this indicator in the following decade was 7.6 percent (see the table), and in recent years has declined even more, being 3.9 percent in the 1979-1980 period.

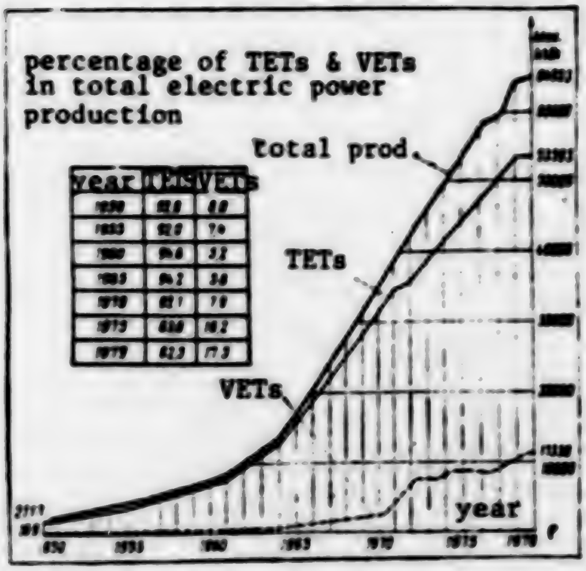


Fig. 1. Electric power output in Romania in 1950-1979 period

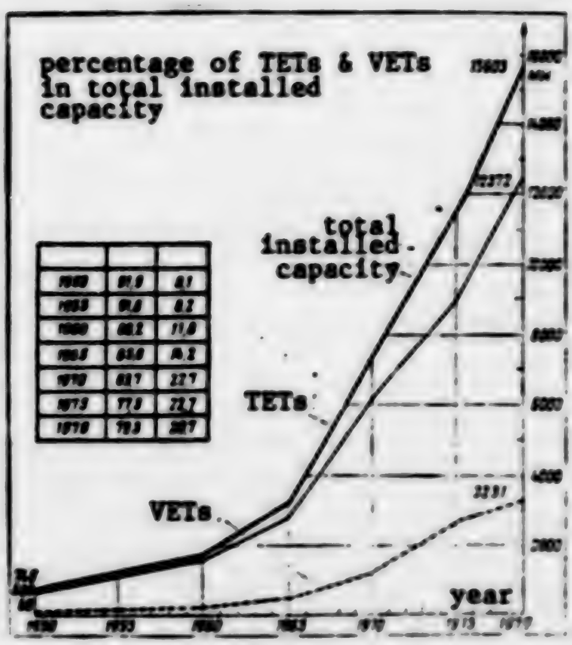


Fig. 2. Installed capacity in Romania during the 1950-1979 period

Percentage increase in electric power consumption and gross industrial product

	1961-1970	1971-1980
Average annual increase in electric power consumption	15.7	7.6
Average annual increase in gross industrial product	12.1	11.2
Ratio between increase in electric power consumption and increase in gross industrial product (lead factor)	1.30	0.68

This decline in the growth rate has been the result of carrying out an extensive program of measures to make more rational and efficient use of electric and thermal power in all areas of social and economic activity. The main directions of the program envisage an improvement in the technologies employed in material production, a reorganization of the production of energy-consuming materials, a revision of the scientific bases for the consumption rates, the use of substitutes for energy-consuming products and so forth.

The Development of Electric Production

The task of more rationally and efficiently utilizing our own energy resources has necessitated the building of thermal power plants [TETs] operating on low-calorific fuels, the development of central heating systems, intensifying the construction of hydropower plants [VETs] and preparations for incorporating atomic power plants [AETs] and new energy sources in the power system for the purpose of utilizing them in the subsequent stages.

The realization of these basic trends is shown in Figs. 1-4.

In terms of the TETs, one can note in first place the greater use of coal for obtaining electric and thermal power from large power plants operating on the low-calorific poles of the Olteni Basin. This has led to an increase in the portion of electric power obtained from coal from 26 percent in 1975 to around 36 percent this year, and a corresponding reduction in the portion obtained from liquid and gaseous fuel from 56 to 40 percent. In line with the development of the condensing plants, we must first point to the recent construction of the first Romanian-produced 330-megawatt turbine units and steam generators with a productivity of 1,035 tons per hour operating on high-parameter steam and reheating.

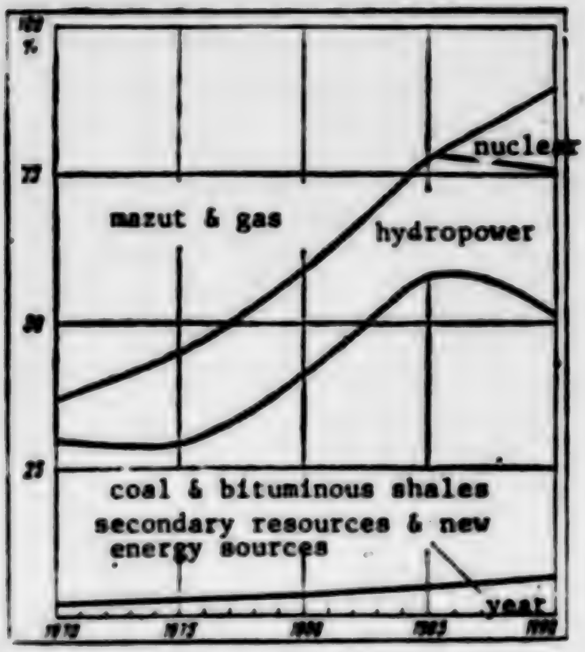


Fig. 3. Structure of electric power output by used resources

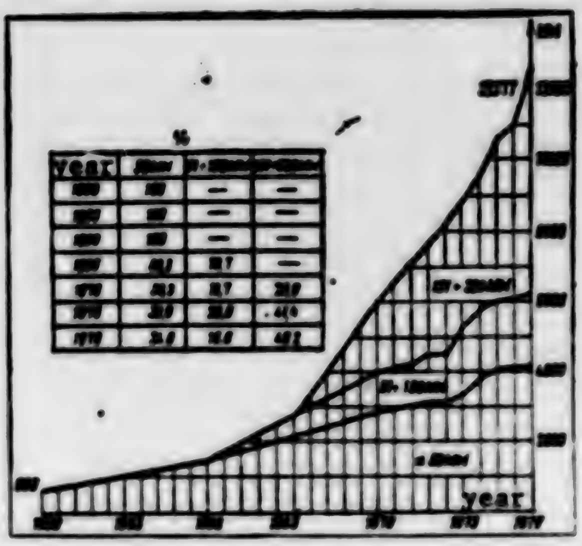


Fig. 4. Change in installed capacity structure of thermal power plants in terms of unit capacity of equipment

Among the large coal-fired TETs built in recent years are the Rovinar TETs with turbine units of 200 and 330 megawatts (Fig. 5); the Turcen TETs partially in operation and which upon completion will have eight 330-megawatt units, two of which will operate on lignites; the Deva TETs with six 210-megawatt turbine units operating on coal, slurry and shale with an average combustion heat of 12,500-14,600 kJ/kg.

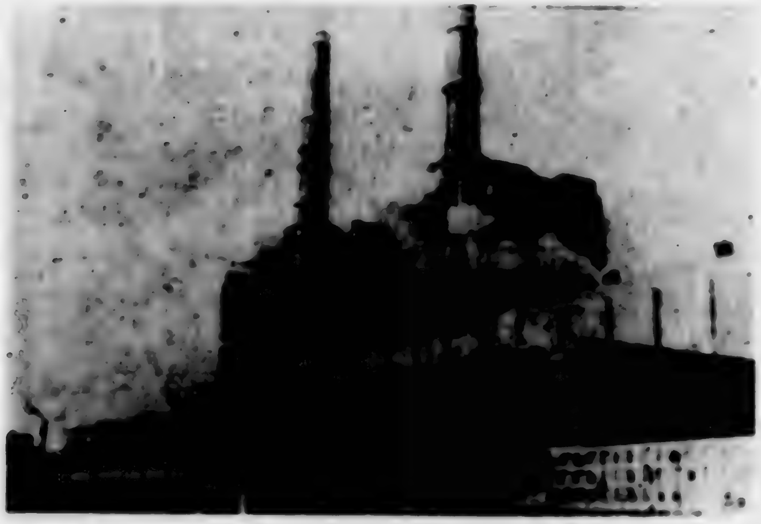


Fig. 5. The Rovinar TETs

Along with these large projects, recently the Romanian power workers have introduced engineering decisions to increase the efficiency of the large TETs by reducing the liquid and gaseous fuels used to stabilize the combustion process in burning lignites from the Olteni Basin, the constructing of equipment to homogenize and enrich the fuel, the use of improved methods to transport and handle fuel, the reutilization of heat in the thermal cycle and so forth.

Particular attention has been given to the introduction and expansion of centralized heat supply as an important fuel-saving measure. Around 25 percent of the installed capacity at the TETs is for heating supply. According to the program for expanding central heating, steam generators have been built with a productivity of 420 tons per hour with 50-megawatt back-pressure turbines, steam generators with greater productivity of 525 tons per hour, and turbines of 150-megawatt capacity and steam reheating, steam generators for 120 tons per hour with 12-megawatt back-pressure turbines as well as small central-heating steam generators produced by Romanian industry.

In order to increase the efficiency of centralized heating supply, heat is transmitted over a distance up to 20 km, using pipelines up to a diameter of 1.2 m for this purpose. As a result of the activities in expanding centralized heat supply, last year around 3 million tons of conditional fuel units were saved.

In order to increase the efficiency of the power plants and particularly the thermal ones, great attention is given to increasing the unit capacity of the equipment. At present the portion of units having a capacity of 200 megawatts and more is around 50 percent (Fig. 4), while the portion of power plants with capacity over 800 megawatts is around 45 percent of the total installed capacity.

As a result of these activities, specific fuel consumption for generating electric power has constantly declined. From 502 grams of conditional fuel per kilowatt hour in 1960, this indicator has declined to 341 grams in 1970 and around 320 grams in recent years.

The past 20 years have also been characterized by the development of hydropower engineering. There has been a continuous rise in the participation of the VETs in the generating of electric power, from 5.2 percent at the start of the period up to 17.5 percent at the end. In terms of installed capacity, the participation of the VETs has been, respectively, 11.8 and 20.7 percent. The use factor for hydropower potential has risen from 23 percent in 1975 to 30 percent in 1980.

Among the basic VETs we must mention first of all the Iron Gates I VETs located on the Danube River and built jointly with Yugoslavia. The capacity of the Romanian part is 1,050 megawatts. The Iron Gates II VETs is in the process of construction.

As a result of fruitful cooperation between Romania and Bulgaria, the Turnu Magurele--Nikopol Hydropower Complex is to be built and the capacity of the Romanian part will be 400 megawatts. This power plant will better utilize the hydropower potential of the Danube River.

A large portion of the potential of the inland rivers has hydropower plants in series in the aim of the best utilization of capital investments. Thus, for example, the Gheorghe Gheorghiu-Dej VETs, has been built on the Arges River with a basic capacity of 220 megawatts and an additional 180 megawatts of capacity in the series; the V. I. Lenin--Bikaz VETs with basic capacity of 210 megawatts and additional capacity of 244 megawatts on the Bistrita and Siret rivers, the Somes--Mariselu VETs with a capacity of 220 megawatts and additional capacity of 60 megawatts on the Somes River, the Sugat-Gilcag VETs with capacity of 300 megawatts and 46 megawatts on the Sebes River, the Lotru VETs with a capacity of 510 megawatts and 133 megawatts on the Lotru and Olt rivers. The use of the hydropower potential has provided an opportunity to improve water supply for the population points and industries in the corresponding zones, to create a secure defense against flooding as well as expand irrigation and the development of fish raising.

For the optimum utilization of hydropower potential, new decisions are being introduced such as the construction of low-pressure VETs with units adapted for utilizing the energy of the downstream current of the rivers, broadening the use of the Francis turbines with a head over 500 m, building reservoir walls out of local materials, building hydropower microelectric plants and so forth.

Development of Electric Networks

The increased consumption of electric power has involved a rise in the transmission capacity. This, in turn, has led to an increase in the transmission voltage of the electric networks. From a voltage of 110 kilovolts used during the 1951-1960 period, we have converted to a voltage of 220 kilovolts in the 1961-1970 period. In the following stage we have been converting to 400 kilovolts which at present is being used evermore widely. As a result of this line of development, the 110-kilovolt power lines are being converted to the distribution network. The transmission network involves mainly 400-kilovolt lines and to a smaller degree the 220-kilovolt lines. A rise in the efficiency of the power plants and the electric distribution networks involves the development of the 400- and 110-kilovolt networks while the use of 220 kilovolts is limited. This is possible due to the introduction of direct 400/110-kilovolt transforming.

In this method favorable conditions are created for reducing losses in the transmission of electric power.

In the area of distribution networks, preference is being given to a voltage of 20 kilovolts for the rural networks as well as for the urban ones while lower and intermediate values are being restricted. In the 1961-1970 period, the 35-kilovolt voltage has gradually ceased to be used, while from 1971 to 1980, a large portion of the existing 15-kilovolt network was converted to a voltage of 20 kilovolts. For the same reason, in Bucharest the voltage of 5 kilovolts has been eliminated and all existing equipment converted to 10 kilovolts.

Particular attention has been given to the use of technical solutions which lead to a decline in network losses. In this regard in addition to avoiding double transforming and the conversion to higher voltages, other tasks have also been outlined such as increasing the cross section of the electric wires by using 3 x 450 phase wires instead of the previously existing 2 x 450 ones, optimizing the paralleling modes of the power sources in the network and so forth. As a result of these activities, losses in the electric networks have been reduced. From 7.84 percent in 1970, these declined to 7.48 percent in 1975 and are now under 6 percent.

Over the 4-kilovolt power transmission lines of Ludus (Romania)--Mukachevo (USSR)--Lemesan (CSSR) and Arad (Romania)--Szeged (Hungary), the Romanian power system can operate in parallel with the United Power Systems [UPS] of the northern socialist nations of Hungary, the CSSR, Poland, the GDR and the western zone of the USSR, and over the 220-kilovolt power line between Craiova (Romania) and Voychinovtsi (Bulgaria) also with the Bulgarian power system. There is one other intersystem link, a 400-kilovolt power transmission line between the Iron Gates (Romania) and Dzerdap (Yugoslavia) over which electric power can be exchanged between the two countries.

Optimization of the National Power System and Increased Reliability

In 1976-1980, measures were taken to further increase the reliability of the national power system. In the first place, dispatching was organized on the following heirarchical levels:

1) State dispatching with the task of monitoring the normal operation of the entire power system and exercising control over the exchange of electric power with the Unified Systems;

2) Territorial dispatching points which monitored the work of the five major zones of the energy system;

3) Local dispatching points for the distributor, municipal and industrial networks in the various subzones.

In order to avoid disturbances and restrict their development, the nation's power system has been introducing automatic safety equipment which sequentially carries out measures depending upon the gravity and duration of the emergency such as disconnecting the system from the major industrial complexes which are powered by their own power plants, the automatic starting up of individual units at the VETs with a power shortage, the separating of individual units at the TETs to meet only internal needs and so forth. Analyses and testing have been carried out for the complete introduction of this automatic equipment in order to achieve a balance between the dependable operation of the equipment in the industrial complexes and the power system as well as between the most important categories of consumers and the internal power supply sources. Concern is also being shown for improving operations, maintenance and repairs as well as for increasing the skills of the operating personnel.

The Development Prospects of the Romanian Power Industry

The further development of the national economy involves a rise in electric consumption within scientifically based amounts. The documents of the 12th RCP Congress held in November 1979 outlined the development prospects of electric power as well as the specific ways for achieving the designated rates and increasing the efficiency of all power engineering.

To carry out the decisions of the 12th Congress a directive program was worked out for the development of power engineering. The basic idea in this program is that the demand for electric power must be in full accord with the real needs of the modern economy based upon strictly determined energy consumption rates. It is planned that the new TETs will operate only on low-calorific fuels, centralized heating supply will be expanded, maximum use will be made of hydropower potential, the first nuclear power plants will be built and new energy sources utilized.

By 1990, electric power generation should reach around 100 billion kilowatt hours which corresponds to an installed capacity at the electric plants of around 28,000 megawatts.

In order to ensure the generation of this quantity of electric power, up to 1990 65 percent of the nation's hydropower potential should be tapped and all of it up to the year 2,000.

In terms of the TETs, we will continue to intensely carry out the tasks of reducing the use of liquid and gaseous fuels, intensify the consumption of low-calorific fuels (lignites and bituminous shales), expand centralized heat supply and introduce units with high unit capacity and steam parameters.

Basic attention will be given to nuclear engineering. At present the Cernavoda AETs is being built and the first unit with a capacity of 660 megawatts should be in operation during this five-year plan. Up to 1990, AETs will be built with a total capacity of around 4,000 megawatts with the aim of reaching a capacity of around 10,000 megawatts by the year 2000.

A number of testings of experimental equipment is being carried out to utilize new energy sources. The obtained results are good. During the next decade, research will be continued so that the new energy sources will be incorporated in the nation's energy balance. The use of secondary energy resources will be expanded, particularly in industry. As a result of these measures, in 1990, electric power production will have the following structure (Fig. 3): 24 percent from the VETs, 44 percent from the coal- and shale-fired TETs, 4-5 percent from the TETs operating on liquid and gaseous fuel, 17-18 percent from the AETs and 10 percent from new sources and secondary resources.

The structure of the energy system will continue to be improved by optimizing the territorial placement of the power plants and particularly the AETs in order to achieve an even distribution of the power sources over the nation's territory and reduce the main transmission lines. At the same time the dependability of power supply will be increased.

Another basic task is to increase the reliability of the power plants and substations. For this purpose we will continue to introduce advanced automatic equipment in the entire energy system. Work will be continued on increasing the reliability of the TETs, the transmission lines and substations. Research will be continued involving heat supply, the mechanical loads on equipment, chemical corrosion, the behavior of electric insulating and pollution. Work will be continued on reducing specific energy consumption both in the energy system and in consumption. Thus, during the 1981-1990 period we must reduce the average value of energy consumption per 1,000 lei of industrial product by at least 40 percent.

The development of the power industry creates new opportunities for broadening cooperation and collaboration between Romania and other nations. There is to be a further study of the questions of developing cooperation with the CEMA countries in uniting the national power systems to provide aid by delivering electric power under mutually advantageous conditions.

A study will be continued on the questions of cooperation with neighboring states for the full use of the hydropower potential of the Danube River, for building AETs, for utilizing new technologies which economize on fuel and energy as well as for developing new energy sources. In this area Romania is interested in broadly developing cooperation with the CEMA countries within the adopted programs with all the socialist countries and other nations of the world in the aim of a just and effective solution to the problems which confront all mankind, for satisfying the need for electric power and its rational utilization.

10272
CSO: 2200/112

DEVELOPMENT OF CSSR POWER INDUSTRY DESCRIBED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 46-50

[Article by Jan Goldschmidt, CSSR first deputy minister of fuels and power and leader of the CSSR delegation to the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "Thirty-Five Years of Successful Development for the Czechoslovak Power Industry"]

[Text] In 1945, the Soviet Army liberated Czechoslovakia from the fascist occupation by Nazi Germany. In February 1948, the working class under the leadership of the Czechoslovak Communist Party [CPCZ] was victorious over the bourgeoisie and began building a socialist state.

Last year we celebrated the 35th anniversary of our nation's liberation and in 1981 we entered a noteworthy year for the peoples of Czechoslovakia, the year of the 16th CPCZ Congress and the 60th anniversary of the party's founding. This gives us an opportunity to assess all that has been done in the past period and all of which our people is rightly proud. The successes of socialist Czechoslovakia are due also to the selfless aid from the USSR and the all-round cooperation of the socialist CEMA nations.

The basic task of Czechoslovak power industry after the nationalization of industry and banks in 1945 was the unifying of around 1,500 enterprises which produced electric and thermal power and gas into a single organization with the task of overcoming the consequences of the occupation. Particular attention had to be given to accelerating the electrification of our nation. Rates had to be unified and above all a state power system had to be created.

At the end of the first stage lasting around 10 years in the building of the power system, installed capacity reached 4,000 megawatts with 2,493 megawatts in 1945.

In 1955, 15 billion kilowatt hours of electric power were produced, continuous power supply was provided for consumers and 92 percent of the villages was electrified.

The following stage which lasted approximately up to 1965 was a stage of qualitative changes in the Czechoslovak power industry. The hithertofore largest hydropower facilities were built at Lipno, Orlik and Kamik and the Vah series of plants was completed. The total installed capacity of the power system reached 5,175 megawatts. The first 400-kilovolt power line and the first 400/110-kilovolt substations were built.

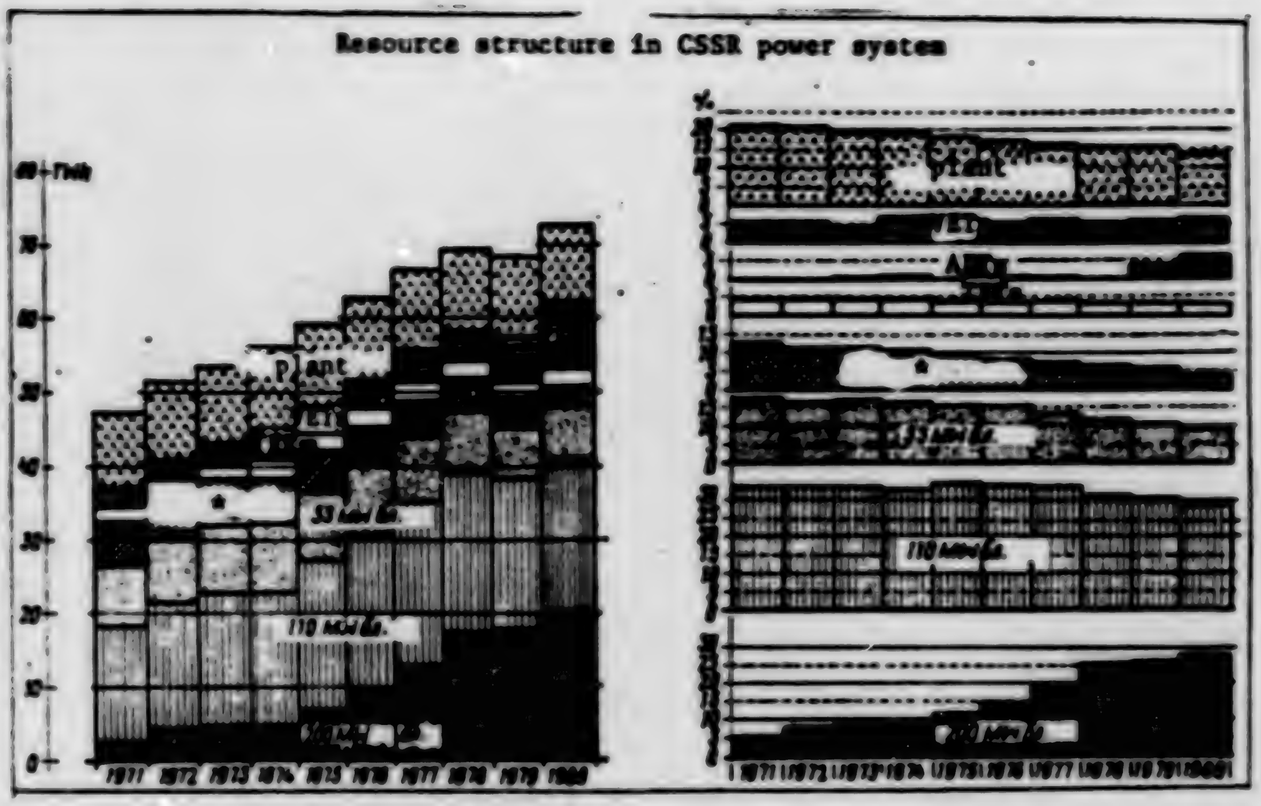
The third stage after 1966 was characterized by the effect of the incorrect views that capital investments into the nation's fuel and power base were unjustifiably high. The construction of the power industry lost its priority and this delayed the completion of plants under construction and disrupted the long-range plan based on the use of cheap power coals. With the exception of the Vojani II TETs, during the 1966-1968 period, construction was not commenced on a single large plant in spite of the fact that the growth of consumption demanded the annual completion of at least 600 megawatts of new capacity.

After 1970, this trend was overcome, planned management and the leading role of thermal and electric power gradually began to be restored. This was reflected in the decisions of the 14th CPCZ Congress held in 1971. On the basis of an analysis of economic development, the congress took a decision to further build up the national economy and to consistently and completely increase efficiency through the full utilization of intensive factors. The next, 15th Congress held in 1976 affirmed the correctness of the decisions taken and emphasized the need for the rational utilization of all types of energy and raw materials.

On the Vltava River, the following electric plants were built: the Orlik with 4 x 90 megawatts, Lipno with 2 x 60 megawatts, Slapi with 3 x 48 megawatts and Kamik with 4 x 10 megawatts. On the Vah River, 17 diversion hydropower plants were built with a total installed capacity of 563 megawatts.

In accord with the needs of the Czechoslovak power system, storage hydropower plants were built to cover the peak loads. In 1949, the first Stehovice PAVETs went into operation with a capacity of 2 x 20 megawatts. In 1975 and 1976, the Liptovska Mara PAVETs was completed stage by stage with a capacity of 198 megawatts, and in 1978 the Dalesice PAVETs with a capacity of 410 megawatts. In 1980, the first 110-megawatt unit began operating at the Cerni Vah PAVETs and its installed capacity will reach 660 megawatts in 1982.

After nationalization in 1945, the power industry inherited relatively developed distribution networks which, however, were rather diverse in design and operating voltage in spite of the progressive 1919 electrification law and the subsequent regulations and standardization. In the networks the highest voltage was 110 kilovolts. For this reason, along with the postwar reconstruction of the damaged equipment, we gradually began to create a unified power system. A major victory for the Czechoslovak power industry was the completing of electrification of the entire nation in 1960.



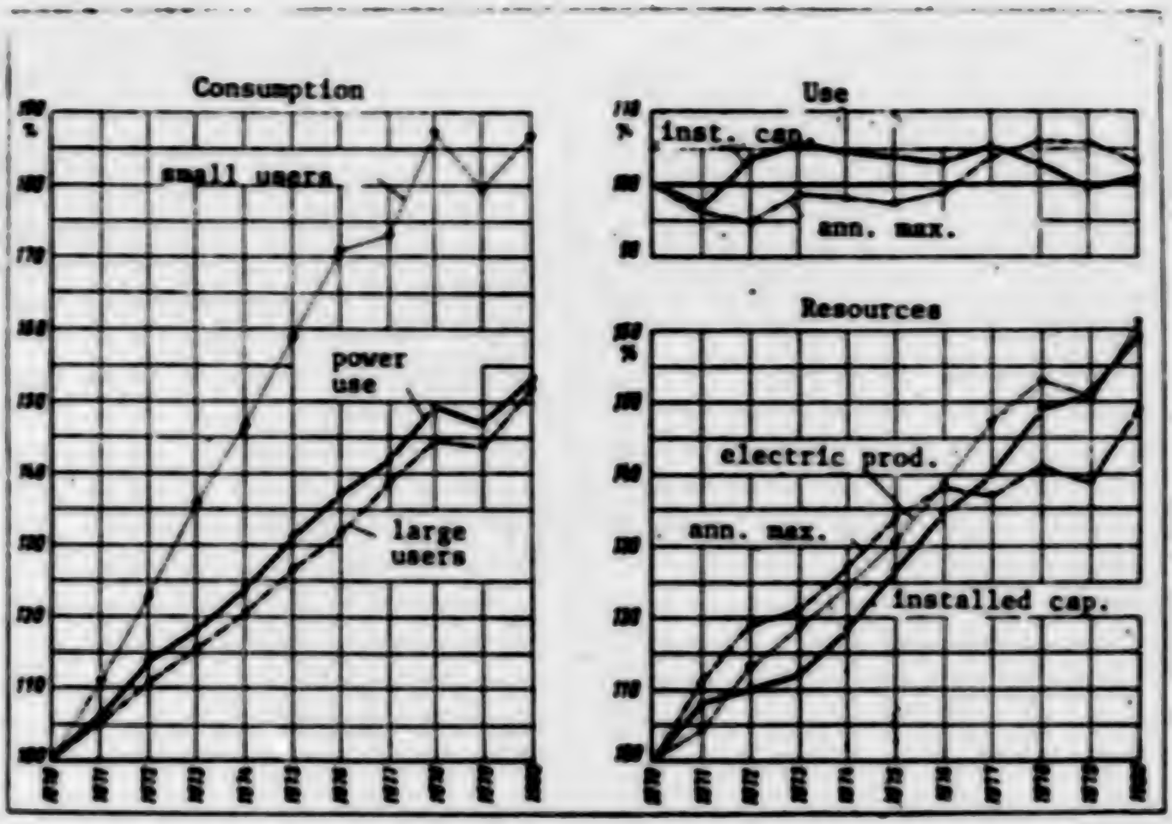
Resource structure of CSSR power system

*--Old condensing-type TETs

The creation of a unified power system and the increased power consumption required that electric power be converted to a higher voltage than 110 kilovolts. In 1952, the first 220-kilovolt line went into operation, and from the start of the 1960's, we began to develop a 400-kilovolt power network.

Simultaneously with the growth of the Czechoslovak power system, the demands on its technical level also increased. For managing the Unified Czechoslovak Power System, in 1958, the Czechoslovak State Dispatching Administration was created with a second hierarchical level, the regional dispatching administrations of "Bohemia," Moravia and Slovakia, and a third heirarchical level of the rayon dispatching points.

The development of the power industry was closely tied to the development of scientific and technical progress in this area. In 1952, the Power Scientific Research Institute was founded and this was the scientific research base of Czechoslovak power engineering and directly under the Federal Ministry of Fuels and Power. The institute carries out specific tasks related to the construction and operation of the thermal and hydropower plants and to the development of the electrical distribution networks and centralized heating supply. Another independent operational and experimental research organization is ORGREZ (Organization for the Rationalization of Power Installations) set up to solve the problems related to modernization and rationalization of equipment in the power system and in the centralized heating supply system.



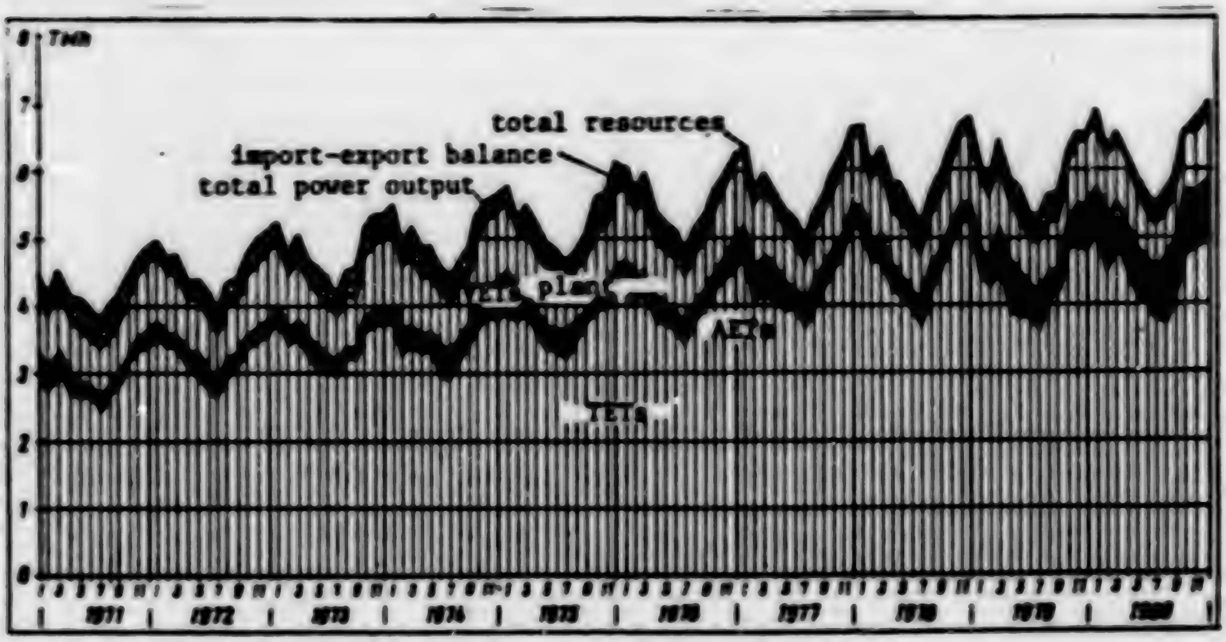
Growth of resources, load, production and consumption in CSSR power system

An important role in the development of Czechoslovak power has been played by Energoproyekt [Power Design] a specialized organization for designing projects in the power system and heat supply. This also carries out long-range studies and participates in the solving of certain scientific research problems.

The successes which have been achieved in the development of the power industry are significant. The future tasks, however, are much more difficult because of the ever-harder securing of primary energy resources. The development rates will be more moderate than was recently assumed. While in 1980 total electric consumption (including the PAVETs) was 75.5 TWh, in 1985 this will be approximately 87.5 and in 1990 100-102 TWh. The output of energy resources and the construction of the power transmission networks will be developed in accord with the anticipated growth of electric consumption.

Great attention is being paid to the rational consumption of electric power and to the development of nuclear power.

The CSSR is a country with high energy consumption and this is caused by the national economic structure characterized by a developed industry with a marked participation of heavy machine building, developed, heavily mechanized agriculture and a high standard of living of the population. In terms of the specific consumption of primary energy resources, more than 7 tons of conditional fuel units per person, the CSSR is in one of the first places in the world. For this reason, in 1976, a State



Structure of electric output in CSSR power system

Specific Program was approved for the rational consumption and use of fuel and energy. This set the task of reducing the energy intensiveness of the processes in all the national economic areas, including in the power industry. In the power industry efforts were focused on reducing the specific fuel consumption for producing 1 kilowatt hour, on reducing internal needs and optimizing losses in the networks.

Condensing-type TETs fired by brown coals hold the basic place in electric power output. This will be maintained until 1990 when they will produce approximately 53 percent of the total electric output. Construction is being completed on the Melnik-III TETs (500 megawatts) and the Prunerzov II TETs (1,050 megawatts) which will be the last classic condensing plants. In the future the solid fuel resources will be employed predominantly for central heating needs.

We will continue to utilize the hydropower potential. Out of the total technically usable potential, approximately 38 percent of the CSSR waters are used. We will develop and rebuild the small VETs with small water quantities and drops. The Gabcikovo--Nadmaros hydropower project is in the process of construction and is being built jointly with Hungary to harness the energy of the Danube River. The share of the CSSR in this project is 423 megawatts. We will complete the Cerni Vah PAVETs (660 megawatts). Construction has started on the Dlouge Strane PAVETs (660 megawatts) and other PAVETs are being readied for construction. The plan is to utilize 61 percent of the hydropower potential in 1990. In spite of this, electric power output from the VETs in 1990 will be only 8 percent of the total production.

Nuclear power plants are a promising source of electric power. For the development of Czechoslovak nuclear engineering and nuclear power machine building, of enormous significance is cooperation with the CEMA countries and particularly with the USSR. The program for the development of Czechoslovak nuclear engineering during this and the following five-year plans is based upon agreements with the USSR dating from 1970, 1976 and 1980 for providing technical aid in the construction of the AETs. The program envisages the construction of 12 VVER-440 units and after 1988, VVER-1000 units.

This program ensures the covering of the increased consumption by electric power from the AETs and makes changes in the structure of the resource base, in placing qualitatively new demands on the other national economic sectors and particularly on machine building. The implementation of the program is impossible without cooperation within CEMA, as it contains not only the mastery of the construction and production of equipment in the CSSR but also considers the allocating of deliveries between the individual CEMA countries. In line with this the Czechoslovak nuclear program is linked to the Agreement on International Production Specialization and Cooperation and Reciprocal Deliveries of Nuclear Power Plant Equipment in 1981-1990.

Along with the development of production capacity, trunk and distribution transmission lines will be developed. The construction of the basic 440-kilovolt network is virtually complete and in the future it will be connected to the 400/110-kilovolt substations. Basic attention will be given to the transmission of energy from large capacity sources and this is a major problem due to a number of limitations of a geographic, ecological and engineering nature. In spite of the difficulties, the length of the 400-kilovolt power lines will increase by 1,350 kilometers up to 1990 (see the table).

Length of power lines, km

	1945	1955	1965	1975	1980	1985	1990
PTL 400 kV	—	—	512	2574	3305	3843	4655
PTL 220 kV	—	630	2786	3026	3083	3085	3024
PTL 110 kV	1275	3550	10213	14826	15823	19300	20100

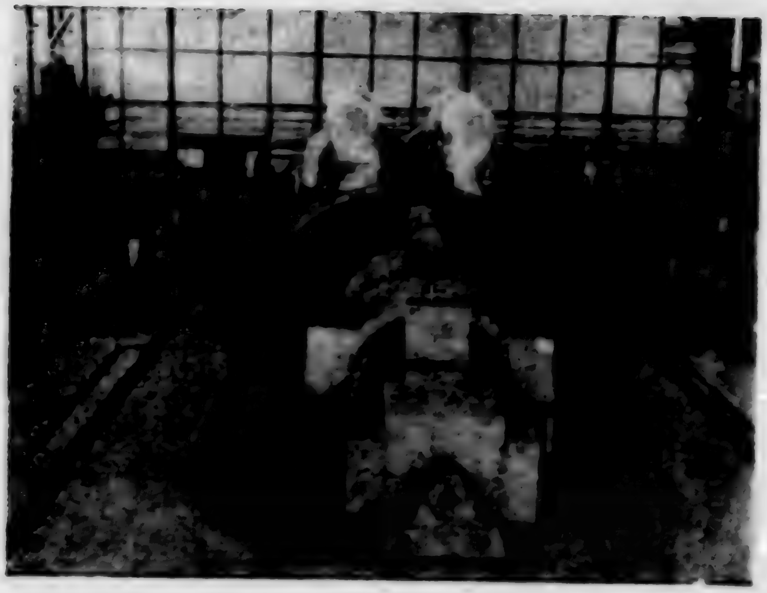
In developing the distribution networks, our efforts will be focused on connecting them to the transformer points as well as on reconstructing and modernizing them to improve their operating capacity and security and better the quality of power supply.

A further deepening of cooperation with all the CEMA countries is of great significance for the development of Czechoslovak power.

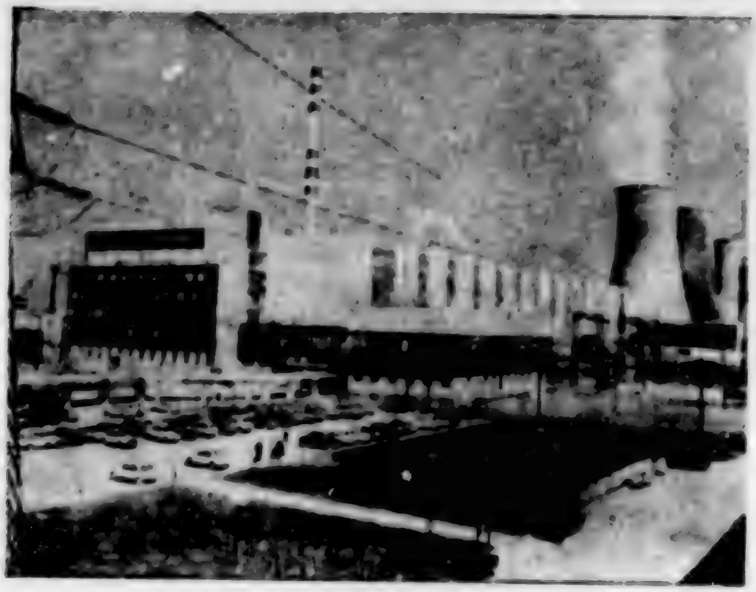
We are participating in carrying out the General Plan, General Agreement and Long-Term Specific Cooperation Program. The CSSR power system is linked to the power systems of the CEMA countries by seven 400-kilovolt lines and five 220-kilovolt ones.

In 1978, the first 750-kilovolt power line was put into operation between Vinnitsa (USSR) and Albertirsa (Hungary). This created conditions to increase electric power deliveries to the CSSR in 1979 by 60 million kilowatt hours, and from the beginning of 1980 by 1.2 billion kilowatt hours annually, with a maximum capacity of 250 megawatts.

In 1979, a General Agreement was signed for joint construction of the Khmel'nitskiy AETs. The CSSR is involved in this. With a total capacity of 4,000 megawatts for the plant our part will be 600 megawatts. Deliveries of electric power will commence in 1984 (0.9 TWh) and from the beginning of 1988 they will be 3.6 TWh annually. Our nation is also involved in building the second 750-kilovolt power line between the Khmel'nitskiy AETs (USSR) and Rzeszow (Poland).



A 500-megawatt unit at the Melnik-III TETs



The Jaslovske Bohunice AETs

The effect from combining the load schedules and reserves for the CSSR in 1980 was 147 megawatts and in 1985 will be 242 megawatts.

These are the more significant integration measures involving our nation. We are also taking an active part in solving a number of problems and questions arising in the process of developing the UPS of the CEMA countries, and here not only scientific research and development but also practical problems. For improving the stability of the UPS we give great attention to constructing the mentioned PAVETs and to the intra- and intersystem power lines.

We have collaborated with Bulgarian power workers for many years now. In 1974, we signed an agreement on direct scientific and technical cooperation between the CSSR Federal Ministry of Fuels and Power and the Bulgarian Ministry of Power Supply encompassing all areas of operation and management of the energy systems and their equipment.

Since 1976, the basic questions of cooperation between the two ministries have been: increasing the reliability and control of the TETs, operation of the networks, the designing and operation of the AETs and the problems of dispatching in the power systems.

For the 1981-1985 period, subjects have been agreed upon for joint scientific research and designing and this will be carried out by the departmental institutes and organizations of the two ministries with substantial attention being devoted to cooperation in the area of nuclear engineering.

The personal contacts of specialists from the CEMA countries also help to deepen cooperation in the area of scientific research, the construction and operation of power projects. These contacts are carried out through bilateral and multilateral cooperation, the mutual exchange of experience and joint work in solving questions of interest to all participating countries.

Without such cooperation and its broadening we could not imagine the further dynamic development of the power industry.

10272
CSO: 2200/112

ROLE OF CENTRAL DISPATCHING ADMINISTRATION REVIEWED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 51-55

[Article by Rostislav I. Grinyuk, director of the Central Dispatching Administration in Prague, CSSR, and Vitold Vitek, deputy director of the Central Dispatching Administration: "The Central Dispatching Administration of the Joint Power Systems"]

[Text] Power engineering holds a basic place in the international economic integration of the CEMA countries. This is determined by the importance of fuels and energy for the development of industry, agriculture and generally for the national economy of the individual countries. The approved plan for multilateral integration measures of the CEMA countries for the 5 years of 1976-1980 included two basic tasks in the power area: cooperation in the use of gas from the Orenburg Deposit, including the construction of a gas line to the western frontier of the USSR and cooperation in the construction and operation of the 750-kilovolt power line between Vinnitsa (USSR) and Albertirsa (Hungary).

The CEMA cooperation program during the new 5-year period also includes a number of important energy questions such as the development of nuclear power, the elaboration of rational forms for the consumption of fuels and energy and the further development of the intersystem super-high voltage 750-kilovolt links.

It is essential to emphasize the great development dynamics of international cooperation in the power area as caused by the universal form of electric power as a power carrier.

In 1962, the governments of Bulgaria, the GDR, Poland, Romania, the USSR, Hungary and CSSR concluded an agreement for setting up the Central Dispatching Administration (CDA) of the United Power Systems [UPS] as an independent economic international organization with the job of coordinating the planned and operating activities of the state dispatching administrations in the power systems of the nations which joined the agreement within their parallel operation.

Over the 18 years substantial quantitative and qualitative changes have occurred in the UPS. The total installed capacity of the UPS has increased by 4.8-fold, the total electric power output by 4.9-fold, the total length of the power networks of 330 kilovolts and higher voltage by 16-fold and the volume of reciprocal electric power deliveries has increased by 8.5-fold. The increase in the qualitative indicators has been aided both by the development of the individual power systems as well as the expansion of their parallel operation in 1979 with the connecting of the USSR Southern UPS via the 750-kilovolt power line running between the Western Ukraine (USSR) and Albertirsa (Hungary). This creates the possibility of parallel operation of the UPS with the USSR JPS [Joint Power System] and for forming a super-powerful association of power systems in the socialist nations from Eastern Siberia in the USSR to the western frontier of the GDR with a total installed capacity of around 320,000 megawatts.

There has also been a change in the qualitative characteristics of the UPS. In 1962, power units with a maximum capacity of 200 megawatts were operating in the power systems, while at present generating units with a unit capacity of 500 and 800 megawatts and high technical and economic indicators have been connected to the common network. Super-powerful power plants have appeared such as the Uglegorsk TETs (USSR) with 3,600 megawatts, Bochsberg (GDR) with 3,020 megawatts, and Kozienice (Poland) with 2,600 megawatts. Along with the thermal and hydropower plants, the nuclear power plants also hold a substantial place in the general capacity and energy balance.

Due to the parallel operation of the USSR JPS, conditions have been created for the stable maintaining of frequency and its deviation from the average half-hour values in established modes is on the order of several hundred hertz.

Operating Results of the UPS in 1980

In 1980, total power consumption exceeded 659,000 GWh and was 3.5 percent higher than total consumption in 1979. Its values for the individual power systems and their annual increases over the last 5 years are shown in Table 1.

Total electric power output by the UPS power plants in 1980 reached almost 669,000 GWh which was 3.3 percent higher than in 1979.

Table 1

Total Consumption of Electric Power in Power Systems
and Its Annual Increase Over the Last 5 Years

Power system	1976		1977		1978		1979		1980 [2]	
	GWh	%	GWh	%	GWh	%	GWh	%	GWh	%
Bulgaria	31076	7,5	32949	6,0	35302	7,1	36267	2,7	38493	6,1
Hungary	25913	6,4	27594	6,5	29861	8,2	30349	1,6	30938	1,9
GDR	89526	5,0	92568	3,4	96776	4,5	98204	1,5	100278	2,1
Poland	103985	7,6	109384	5,2	115164	5,3	116967	1,6	121635	4,0
Romania	56793	11,5	59533	4,9	62446	4,9	64038	2,5	67764	5,8
USSR--South UPS[1]	15489	9,9	15961	3,0	214224	...	219750	2,6	225509	2,6
CSSR	66656	5,0	69051	3,9	72545	5,0	71408	—1,6	74584	4,4
UPS	389438	7,1	407060	4,5	626318	...	636992	1,7	659151	3,5

[1] Prior to 1977, the USSR L'vovenergo [L'vov Power Administration]

[2] Preliminary data

In 1979 and 1980, the percentage of the following participating sources in total electric power output was:

	1979	1980
Classic TETs	80.6	79.6
AETs	4.7	5.5
VETs	5.2	5.9
Industrial power plants	9.5	9.0

The generated electric power in 1980 for the individual nations was as follows (GWh): 34,602 for Bulgaria, 23,550 for Hungary, 98,813 for the GDR, 121,870 for Poland, 67,340 for Romania, 249,779 for the USSR Southern UPS, 72,695 for the CSSR and 668,649 for the UPS.

The total installed capacity of the UPS power plants on 31 December 1980 was 137,000 MWh with an annual increase of 2.8 percent. The increase in the installed capacity last year was more than 2,500 megawatts at the classic TETs and AETs and 1,066 megawatts at the hydropower plants.

The UPS creates prerequisites for increasing the unit capacity of the power units. In 1980, nine turbine units were put into operation with a capacity of 200 and more megawatts. As a result of this at the end of the year the UPS had in operation 272 such turbine units with an installed capacity of 68,630 megawatts. This was 50.1 percent of the total installed capacity of the TETs in the power industry.

The total annual load maximum of the UPS was realized on 9 December 1980 at 1700 hours and reached 99,936 megawatts (the southern UPS participated from the USSR power system). The potential effect from combining the load schedules in December 1980 was 2,036 megawatts. This effect calculated in the percentage of the total maximum loads of the power systems during the individual years of the last 5 years is shown in Table 2, and as an average for the 5 years and for 1980 in Fig. 1.

Table 2

Potential Effect from Combining Load Schedules of Power Systems

month	1976		1977		1978		1979		1980		average for 1976-1980
	MW	%	MW	%	MW	%	MW	%	MW	%	%
1	1622	2,7	1811	2,9	2379	3,6	2306	2,6	2371	2,3	2,8
2	1473	2,5	2099	3,4	644	1,0	2652	2,7	1642	1,7	2,3
3	923	1,6	996	1,6	567	0,9	1718	1,8	1176	1,2	1,4
4	966	1,8	1244	2,2	1149	1,9	2632	2,9	2224	2,4	2,2
5	838	1,6	1662	3,1	735	1,3	2904	3,4	4117	4,8	2,8
6	2073	4,1	1256	2,4	1847	3,4	2177	2,7	1654	2,0	2,9
7	2669	5,3	2438	4,7	2412	4,5	2581	3,2	3606	4,4	4,4
8	1255	2,4	950	1,8	695	1,2	2522	3,0	3614	4,3	2,5
9	690	1,2	1054	1,8	336	0,5	1910	2,2	1320	1,5	1,4
10	841	1,4	1010	1,7	681	1,4	1931	2,0	2035	2,2	1,7
11	1399	2,2	1381	2,5	1150	1,7	2013	2,1	2305	2,5	2,2
12	1777	2,8	1860	2,8	1173	1,7	2723	2,8	2036	2,0	2,4

One of the most important indicators for the operation of the UPS is the increase in mutual deliveries of electric power within the UPS. Among the member nations of the CDA this value reached 29,422 GWh, that is, 2,871 GWh more than 1979 (1.1 percent). The amount of the exchange of electric power in 1980 outside the UPS considering the exchange between the southern UPS and the JPS of the USSR was 51,206 GWh.

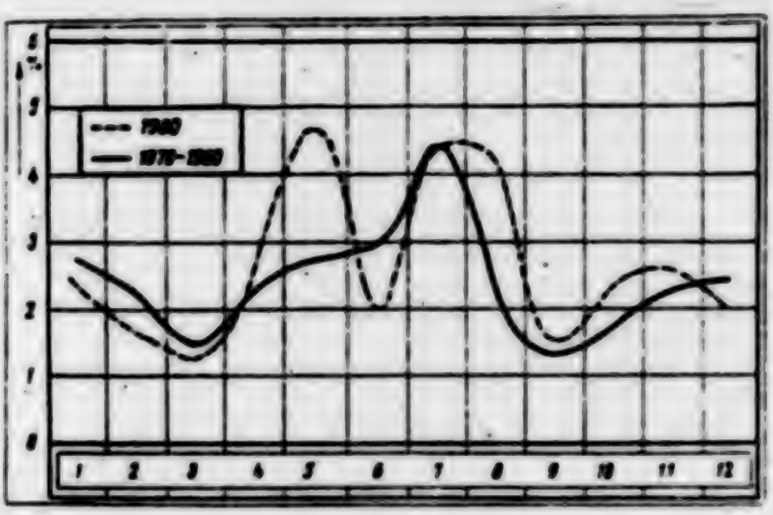


Fig. 1. Effect from combining load schedules in percent of total maximum loads for individual power systems

The volume of the planned electric power deliveries in 1980 increased in comparison with the previous year and there was also a rise in the multilateral operating unplanned deliveries.

Fig. 2 shows the volume of electric power considering the deliveries between the UPS and the power systems outside the UPS. The total volume of these deliveries was 52,206 GWh and comprised 4.5 percent of the total production of electric power in the power systems of the CDA member nations.

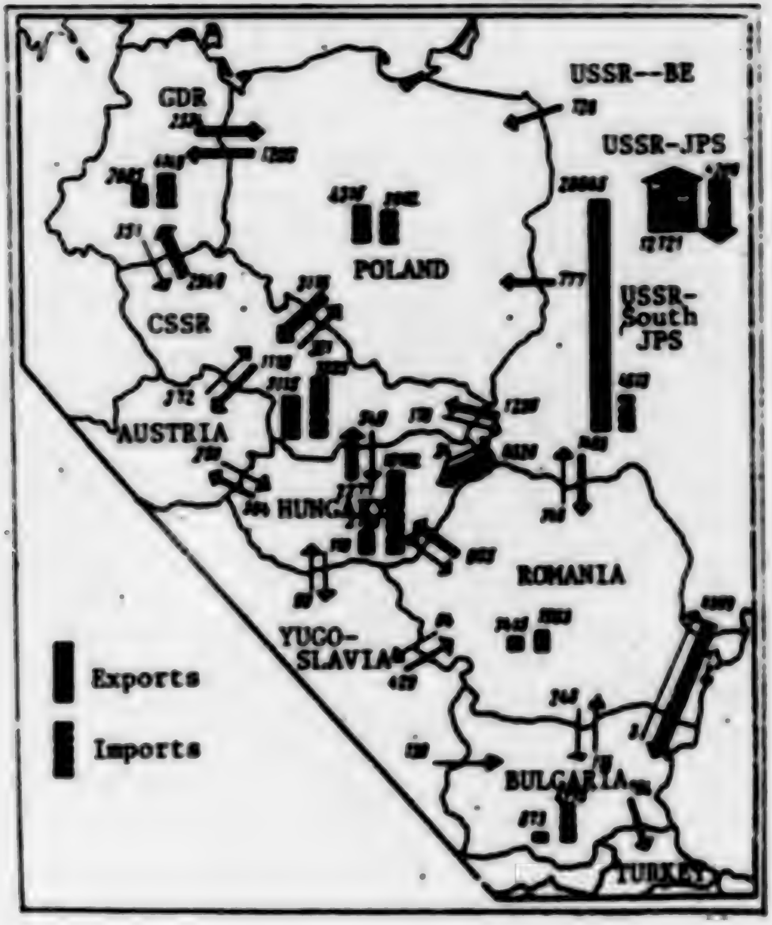


Fig. 2. Actual deliveries of electric power between neighboring power systems in 1980, GWh

An important condition for ensuring the reciprocal exchange of electric power is the operating capacity of the system-forming networks, including the high-powered lines of intersystem significance. These power lines must handle not only the transmitting of the planned flows of capacity and energy but also provide for the transmission of capacity related to the regulating of the capacity balances in the individual power systems.

At the end of 1980 parallel operation of the UPS was carried out over one 750-kilovolt power line between the Western Ukraine (USSR) and Albertirsa (Hungary), over seven 400-kilovolt lines and fourteen 220-kilovolt lines with a total operating capacity of 13,800 MVA. A diagram of the system-forming intersystem power lines and their rated operating capacity are shown in Fig. 3.

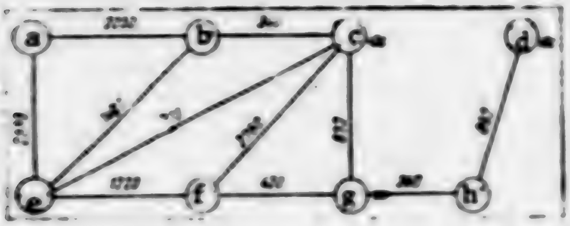


Fig. 3. Diagram of intersystem system-forming power lines in the UPS

Key: a--GDR; b--Poland; c--USSR southern UPS; d--USSR southern UPS; e--USSR; f--Hungary; g--Romania; h--Bulgaria

Modernization of the Dispatching Point of the CDA

The increase in the amount of mutual power deliveries, the broadening of the parallel operation of the UPS and the converting to the parallel operation of the UPS with the USSR JPS--all of this has placed increased demands on coordinating the UPS operations. For this reason and in line with the obsolescence and technical age of the equipment at the CDA Dispatching Point, a decision was promptly adopted by the CDA Council to fully modernize the equipment used for the purposes of coordinating UPS operations.

The full modernization was divided into three parts: modernization of telemechanics and communications, of the dispatching board, panel and telephone exchange and automated teledata processing.

The entire range of measures was gradually introduced from 1978 and was completed in 1980 with the opening up of the automated teledata processing.

Modern Czech-produced third-generation equipment was installed for telemechanics of the TZD-751 type and for communications of the UFT type. The amount of telemechanical devices and communications was determined over the long run considering the General Plan for the Long-Range Development of the United Power Systems of the CEMA Countries for the Period Up to 1990. The teledata received by the equipment of the CDA dispatching point in Prague is used in a digital form for display on the dispatching panel and in an analogue form is delivered to the recorders and the input of the automatic data processing system. Also installed were an advanced dispatching panel of the DUS type, a board of the DP-2D type and a telephone switchboard produced by the COMEX plant (all the equipment is Czech manufactured). The dispatching room of the CDA after modernization is shown on the back cover [not reproduced]. One can see the digital displays positioned at the dispatcher board and these are part of the automatic teledata processing system using a Hungarian-produced ES-1010 computer as well as the GDR-produced air conditioner.

An overall view of the computer and peripheral equipment room is shown in Fig. 4.

To perform the functions of automated teledata processing, the Soviet organization VNIIYe [All-Union Scientific Research Institute for Power Engineering] has developed and introduced the software making it possible to carry out the following:

1) Input of the transmitted teledata and checking of its reliability;

2) Storage of the teledata in five files with differing density and depth of storage for the purpose of ensuring repeated retrospective review;

3) The keeping in a tabular form and as diagrams the operating parameters of the UPS (the import and export balance of the nations and the monitoring of its fulfillment by the planned flows over the power lines, the frequency, voltage and so forth);

4) Tracking disruptions of the technical limits of operating parameters and warning with the appearance of a disturbance;

5) Depiction of the detailed systems of the substations and structural schemes of the UPS;

6) Display of a cycle of routine information as chosen by the dispatcher;

7) Printing of documents and selected cycles of data by an automatic digital printer.

It must be pointed out that the full modernization has achieved its aim as there has been a significant increase in the working efficiency of the CDA dispatchers and it is possible to provide the dispatching administrations of the various nations sufficiently dependable and detailed information on the operation of the UPS.

Fig. 4. Room for the ES-1010 computer and peripheral equipment

Urgent Problems of Managing the UPS of the Participating Countries at the CDA

The parallel operation of the UPS, after the connecting of the USSR JPS, represents a new stage in the technical and economic development of the CEMA UPS and which differs substantially from the previous period. This applies particularly to the operating conditions. The transition to this stage, the result of completing the 750-kilovolt power line between the Western Ukraine and Albertirsa, was studied in detail while being designed. To ensure dependable operation of the UPS, new common-system automatic safety equipment was incorporated which would prevent the occurrence of asynchronous running.

All the particular features of the new stage of the UPS could be understood only in the process of operating it. With the completion of the 750-kilovolt power line between the Western Ukraine and Albertirsa there was a significant increase in the planned electric power deliveries from the USSR to Hungary, the GDR and the CSSR. The amount of operating unplanned deliveries of electric power increased and this exacerbated the problem of regulating and restricting the flows of exchange capacity, particularly over the L'vov section.

In view of the fact that the installed capacity of the USSR JPS surpassed the installed capacity of the UPS by 2.5-fold, the L'vov section was also loaded by the unexpected increased power flows as a result of the emergency drop in the generating sources in the power systems to the west of the L'vov section. The addition of such flows to the unplanned importing of electric power in the western direction can lead to the tripping of the automatic safety equipment and to the temporary interruption of the parallel operation of the UPS with the USSR JPS.

The Albertirsa substation in Hungary

In 1980, on the basis of the acquired experience within the CDA, a complex of additional technical, organizational and economic measures was worked out to increase the reliability of UPS parallel operations. In technical terms there was to be an improvement in the safety measures in the L'vov section. The outlined technical measures were aimed at ensuring precise operation of the automatic safety equipment and relays, reciprocal reserving and improving parallel operations of the UPS from the standpoint of dependability.

Among the organizational measures was the review of all technical instructions on the operation of the UPS in order to ensure the best definition and finding the optimum methods for running the UPS.

At the center of the economic measures was the elaboration and introduction of an improved economic incentive system meeting the new conditions for the parallel operation of the UPS. This system, along with the technical measures, should help to prevent emergency situations and rapidly eliminate arising emergency situations in the UPS.

Along with solving current questions, great attention must also be paid to the future development of the UPS. For this reason within the CDA, we have begun to work out the questions related to increasing the reliability and more fully utilizing the economic advantages of parallel operation of the UPS by increasing the exchange of electric power, realizing the intersystem effects and lowering the common capacity reserves under the conditions of completing the subsequent 750-kilovolt power lines and first of all the power line between the Khmel'nitskiy AETs (USSR) and Rzeszow (Poland).

10272
CSO: 2200/112

DEVELOPMENT OF CEMA UNITED POWER SYSTEMS DESCRIBED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 56-58

[Article by Georgiy A. Ilarionov, first deputy chief of the Main Economic Planning Administration of the USSR Ministry of Power and Electrification and chairman of Section 1 of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "The United Power Systems of the European CEMA Nations"]

[Text] Electric power is one of the areas where, on the basis of extensive cooperation between the CEMA countries, international economic and scientific-technical ties are being successfully realized and developed. In this regard the creation of the united power systems (UPS) of the European CEMA nations holds an important place and has produced remarkable results in satisfying the demand for electric power and increasing the efficient operation of the nations' power system.

The organization of the parallel operations of the European CEMA UPS, the Joint Power System [JPS] of the USSR and the Central Power System of Mongolia has led to the formation of a power association which has no equal in the world in terms of the scope of the territory reaching 8,000 km in width. The total capacity of the power plants operating jointly in the power association surpasses 350,000 megawatts.

This qualitatively new stage in the operation of the CEMA UPS has created conditions for a further increased efficiency from their collaboration in the area of electric power.

Basic Stages and Results from Cooperation in the Creation and Development of the CEMA UPS

The organizing of large power associations and their integration outside the limits of national power systems by the building of international power lines has been characteristic for present-day electric power. Along with solving the problems of the interchange of electric power, such intersystem power lines make it possible to realize the so-called intersystem effect which is achieved by the joint operation of the power systems. The intersystem effect of the association, depending upon the concrete conditions, can be determined by various factors. First of all one must consider the possibility of providing emergency mutual aid and a corresponding rise in the dependability of power supply or a decline in the necessary capacity reserve in the individual power systems. Of substantial significance is the discrepancy in the configuration of the load schedules in the individual power systems and the times of the daily and annual electric load maximums.

The socialist method of management makes it possible to realize the basic effect from the integrating of the power systems. This consists in working out and implementing over the long run a plan for the development of the individual power systems. There are also plans for progressive and highly efficient technical solutions in building the power projects and utilizing the energy resources. This is possible with the joint operation of the power systems. This applies predominantly to the choice of the plans for utilizing hydropower resources, the increased unit capacity of the thermal and nuclear power plants and their equipment, the use of even higher rated voltages in the power lines and so forth.

For solving such problems, in 1958, a Section for Power Systems and General Power Questions or Section 1, was organized as a working body under the Permanent CEMA Commission for Cooperation in the Power Engineering Area.

The section is concerned with the questions of the long-range development of the CEMA UPS, including the development of the electric networks.

Among the basic areas of collaboration for which Section 1 works out materials and proposals are:

1) The coordinating of electric power development plans for the CEMA countries over the 5 years;

2) Development of electric power and assistance in ensuring electric supply of the CEMA countries; raising the reliability level of electric supplies; more fully utilizing the technical and economic advantages of parallel operation and internal fuel and energy resources;

3) The forming of an optimum structure of generating capacity within the state power systems; the configuration of the UPS electric networks; the sequence and dates for building power plants on the basis of technical and economic analysis;

4) Improving the existing forms for coordinating parallel operations and organizing UPS operations;

5) Draft treaties as well as considerations on the basic principles and rules for cooperation among the nations in building and operating the joint power facilities;

6) Raising the technical level in the area of designing, building and operating the electric networks and so forth.

Participating in the work of Section 1 are delegations from all the CEMA nations on the commission as well as the Yugoslav delegation on the basis of the collaboration treaty between CEMA and the Yugoslav government.

The multilateral cooperation of the nations on these problems started in 1956 with the preparation of proposals to increase the exchange of electric power between the CEMA countries over the period up to 1960.

In 1958, Section 1 prepared a report on the unifying of the power systems of the CEMA countries and the interchange of electric power to satisfy their needs. The basic areas were outlined for cooperation in the electric power area for the period up to 1965. The report contained specific proposals for connecting the power systems in the individual countries to parallel operations by building intersystem power lines and constructing large-capacity power plants. An approximate assessment was given for the economic effect which would be obtained by the nations from the joint operation of their power systems.

With the carrying out of the report's recommendations, a start was made to setting up the CEMA UPS. In 1960, several intersystem links were built with a voltage of 220 kilovolts. With the completion of them, parallel operation was started in the power systems of Hungary, the GDR, Poland and CSSR. The power supply in the border areas over these power lines from the nearest power plants of the neighboring nations led to a substantial decline in the electric power losses. There was no necessity of strengthening the domestic power networks of these countries.

In 1962, a double 220-kilovolt power line was put into operation between Mukachevo (USSR) and Sajoszeged (Hungary) for transmitting Soviet electric power to Hungary. Thus, the L'vov power system of the USSR was connected in parallel operation with the power systems of Hungary, the GDR, Poland and CSSR. In 1963, the Romanian power system was connected in parallel to them over the 400-kilovolt power line between Ludus (Romania)--Mukachevo (USSR)--Lemesani (CSSR). Over this power line electric power was exported from Romania to the CSSR. With the completion of the 220-kilovolt power line between Craiova (Romania) and Boychinovtsi (Bulgaria) in 1967, the unifying of all the European CEMA power systems was completed for parallel operation. For coordinating parallel operation of the CEMA UPS, in 1962, an international organization, the Central Dispatching Administration (CDA) was founded on the basis of a multilateral agreement between the member nations of the association.

In its activities the section directs the cooperation between the nations in improving the parallel operation of their power systems and the construction of the most important intersystem and domestic 220- and 400-kilovolt power lines. At the same time there has also been a rise in the power base of the UPS nations. The Soviet Union has given them great fraternal assistance. On the basis of the studies of the section and with Soviet assistance, a number of large power plants have been built in the nations. The electric power shortages in certain nations have been covered by imports from the USSR. The Burshtyn TETs has been used as the base power plant. Power from it was transmitted via the key 400/420-kilovolt Mukachevo substation built on the basis of multilateral cooperation. In addition to this, a portion of the power was transmitted from the USSR to the border areas of Poland over a 220-kilovolt power line between Ross' and Bialystok (1962) and a 220-kilovolt power line between the Dobrotvor TETs and Zamosc (1965).

For transmitting electric power to Bulgaria, in 1972, a 400-kilovolt power line was put into operation between the USSR and Bulgaria (the Moldavian TETs--Vulkanesti--Dobrudzha) some 447 km long. For increasing its operating capacity up to 860 MVA at the Vulkanesti Substation equipment was installed for longitudinal capacity compensation.

Of great significance are the studies of Section 1 for each 5-year period in examining the expected capacity flows, determining the mutually advantageous parallel operations of the UPS and examining the static and dynamic stability of the parallel operations and the short circuit currents. Here specific measures have been worked out increasing the reliability and efficiency of the UPS operations.

The development of materials and proposals by the Section are of significant importance in coordinating the five-year plans for long-range power development of the CEMA nations. These are used by the countries in compiling their five-year plans for national economic development and in coordinating the power development plans. They cover a broad range of questions involving coordination in the scientific research, designing, construction and operation of power projects through the exchange and introduction of the most progressive achievements. In the course of coordinating the national economic development plans of the CEMA countries, questions are coordinated related to satisfying the needs of the nations, including the importing and exporting of electric power.

A large portion of the section's work is taken up by the compiling and improving of procedural materials.

In 1971, the 25th CEMA session approved a comprehensive program for further satisfying and improving cooperation and developing socialist and economic integration among the CEMA countries for 15-20 years. At present the carrying out of the comprehensive program is the chief content in the multilateral economic and scientific-technical cooperation between the CEMA countries.

One of the most important measures of the comprehensive program is the broadening of parallel operation of the UPS. In this regard the 26th CEMA Session recommended the construction of intersystem 750-kilovolt power lines between the interested nations.

Upon the commission's instructions, Section 1 worked out the feasibility studies for building the first intersystem 750-kilovolt power line between Vinnitsa--Western Ukraine (USSR)--Albertirsa (Hungary), and after this drew up the preliminary plans for it.

The 750-kilovolt power line was built by the joint efforts of the involved CEMA countries and was put into operation in 1978. This was the first international power line of such a voltage class. It is 842 km long. With its completion the scope of parallel operations was significantly broadened. The operating capacity of the intersystem links has been increased. Dependability has been raised in the parallel operation of the UPS. An opportunity has appeared to obtain a substantial economic effect by the discrepancy in the load schedules and capacity reserves. This provides a savings of capital investments in building new power plants.

At present, the CEMA UPS produce 21.6 percent of the total electric power produced in the world. In all the power systems, the forming of 400-kilovolt networks is being completed, and in the western regions of the USSR, 330- and 750-kilovolt systems. At present the power systems are united by 26 intersystem links of 220, 400 and 750 kilovolts with a total current capacity of around 15,000 megawatts.

The growth rates of the total exchange are significantly higher than the production of electric power in the nations as is seen from the following data:

	1960	1965	1970	1975	1979
Exchange of electric power, billion KWh	1.7	5.6	13.2	20.1	29.4

In benefiting from the advantages of the UPS, the CEMA nations have built such large power plants as the Burshtyn TETs (USSR) with 2,400 megawatts, Bochsberg (GDR) with 3,020 megawatts, Kozienice (Poland) with 2,600 megawatts, Turow (Poland) with 2,000 megawatts, Lubmin (GDR) with 1,760 megawatts, Rovinar (Romania) with 1,720 megawatts, Rybnik and Dolna Odra (all in the USSR) with 1,600 megawatts each and so forth.

Nuclear power plants are operating in the USSR, GDR, Bulgaria, CSSR and elsewhere.

With the consolidating of power plant capacity, there has been a rise in the unit capacity of equipment. In 1979, the UPS had in operation units from 200 to 500 megawatts with a total capacity of 66,400 megawatts. This is 70 percent of the total installed capacity (for the USSR, the data are taken for the southern UPS).

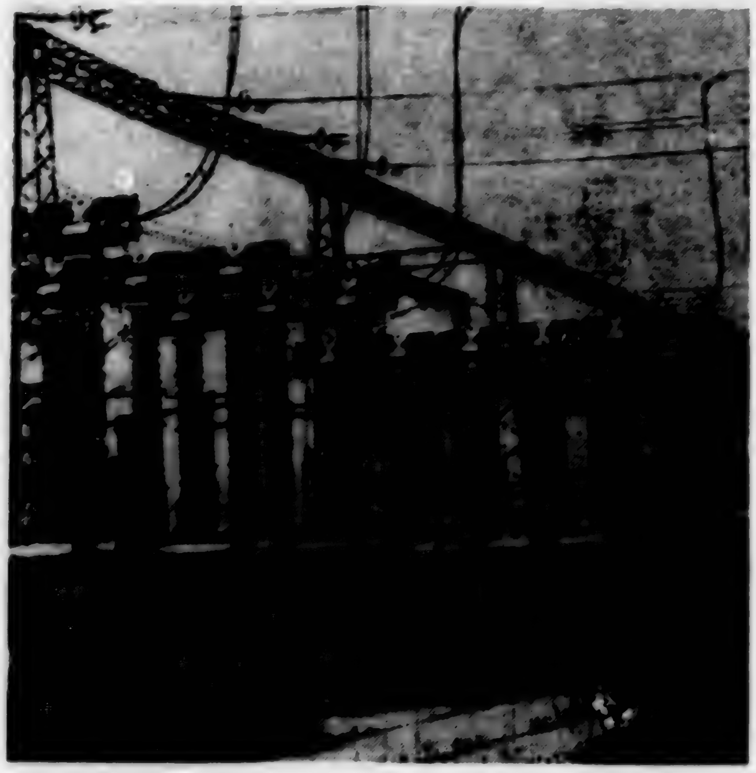
Prospects for Further Cooperation in Forming the CEMA UPS

The most important work of the section in recent years according to the decision of the council session and the instructions of the commission is the General Plan worked out in 1975-1976 for the long-range development of the CEMA UPS. Here are taken up the questions of collaboration in this area, including with the Yugoslav power system.

The draft of the General Plan was reviewed and approved by the 30th CEMA Session as the basic direction for collaboration in the development of the CEMA UPS. Materials from the countries on the long-range development of the national power systems were incorporated as the basis of elaborating the General Plan.

The General Plan outlines the ways to satisfy the growing need for electric power by the CEMA countries and Yugoslavia over an extended period (15-20 years). It provides for the fullest use of the economic advantages of the joint operation of the power systems by increasing the interchange of electric power, realizing the intersystem effect and reducing capacity reserves.

The General Plan also provides for a further rise in the technical level of power engineering by building high-powered thermal and nuclear power plants and power lines with increased current capacity and the fuller utilization of all types of fuel and hydropower resources, including low-calorific solid fuels.



400-kilovolt equipment at the Dobrudzha Substation in Bulgaria

The development of nuclear power will be carried out on the basis of broad cooperation between the interested nations in producing the AETs equipment.

For the purpose of the more rational and economic use of the thermal power resources in producing and consuming electric and thermal power, the General Plan envisages the elaboration and implementation of a range of measures.

A substantial fuel savings can be gained by the fuller utilization of the available hydropower resources in the countries. Important in this regard is the implementation of a plan to make complete use of the hydropower resources of the Danube River. Series of VETs can be created by the joint efforts of the involved nations.

The general scheme envisages the construction on a multilateral basis of a number of pumping and storage power plants (PAVETs): the Lakatnik in Bulgaria, Predikalosek in Hungary and Dzerdap III in Yugoslavia. The urgency of building the PAVETs to a great degree is determined by the outlined program for constructing nuclear plants. As highly maneuverable power plants, the PAVETs are effective under the conditions of the UPS and can be used for an emergency and load reserve.

At present, Sections 1 and 3 of the commission are investigating the efficiency of the PAVETs and the technical and economic calculations for the first PAVETs.

The development of the CEMA UPS will be carried out stage-by-stage. The outlined measures will be realized in accord with the principles stated in the Comprehensive Program for socialist internationalism, on a basis of considering state sovereignty, independence and national interests, noninterference into the internal affairs of the countries, complete equality of rights and voluntariness, mutual advantage and aid.

In working out the General Plan multivariant calculations were run for the capacity and energy flows. The stability of the parallel operation of the national power centers was figured. The calculations and research showed that the optimum is the constructing of 750-kilovolt networks. The designated variation for building the power lines will significantly strengthen the intersystem links, it will increase the reliability of parallel operations and will ensure uninterrupted electric supply for the consumers.

At present the plans are being worked out for a 350-kilovolt power transmission line between the Khmel'nitskiy AETs (USSR) and Rzeszow (Poland), some 380 km long. The power line will be of great significance for the dependable parallel operation of the central portion of the UPS and for transmitting electric power from the Khmel'nitskiy AETs built by the joint efforts of the involved countries.

Work is continuing on drawing up a draft agreement for the construction of still another 750-kilovolt power line for transmitting electric power to Bulgaria and Romania from the Southern Ukraine AETs under construction with a capacity of 4,000 megawatts.

Within the Long-Range Specific Cooperation Program there are plans to further work out the development plans for the basic intersystem 750-kilovolt network. This is aimed at a greater concentration of power production and the centralizing of electric supply using large power units from the condensing power plants and power reactors with a capacity of 1,000 and more megawatts.

In the planned development of the UPS, of important significance is extensive collaboration between the CEMA states in the area of science and technology.

10272
CSO: 2200/112

ACTIVITIES OF SECTION ON THERMAL POWER DEVELOPMENT VIEWED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 59-60

[Article by Stanislaw Kus, general director of the Polish Southern Power District and chairman of Section 2 of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "The Contribution of Section 2 to Increasing the Efficiency and Reliability of the TETs"]

[Text] As is known, in order to obtain the desired efficiency in solving complicated technical and economic problems, it is essential to have highly skilled specialistws with great practical experience.

Such personnel is employed at the electric plants, institutes and plants of the CEMA countries. Section 2 in its activities relies on the results and achievements of their work. It must be stressed that the representatives of the section are operations specialists, designers and metering specialists. Such a composition guarantees quality work in the section.

As an example one might point to certain basic subjects in multiyear plan of Section 2. These have contributed to improving the efficiency and reliability of the power plants of our nations and would include such subjects as KT-92a "Development of New Large Automated Units, Improving Operations of Existing Power Plants with Large Automated Units and the Elaboration of Proposals for Their Production on a Basis of Specialization and Cooperation" or subject KT-92b "Improving Operations of Existing Power Plants with Large Automated Units."

The mentioned subjects contain proposals made by the specialists on the basis of their enormous operational experience for designing and producing more dependable and efficient power equipment, the questions of improving operational achievements as well as the exchange of experience. Each main subject includes a number of subthemes such as:

1) Improving the operational conditions of large automated units and electric plants fired by solid fuel;

2) Improving the preparation and combustion of solid fuel in the TETs with large automated units;

3) Modernization of basic equipment in power plants with large automated units.

These are just a few of the subthemes worked out and found in subject KT-92 and deal with specific problems involving the operation, design, construction, fuel economy and so forth. The coordinator of each subtheme is the nation which has the best achievements in the given area. In this manner a range of problems is worked out involving the TETs and they are solved on the basis of the best achievements and experience of our nations in this area.

It must be pointed out that the subject KT-92b.8 "Generalization of the Experience of the CEMA Countries and Yugoslavia in Operating Thermal Power Plants with Units of 200 Megawatts and Over in 1979-1980 and the Elaboration of Proposals to Improve Reliability and Economicness of the Power Units" is worked out by the section annually. This provides a systematic exchange of experience between the power engineers of our countries. To a certain degree the subject is a source of the themes for elaborating the annual and long-range plan of Section 2, since the operational experience, in considering the achievements and failures in practice, guarantees a correct selection of the essential studies which provide specific results.

As is known, at present there is a world problem of saving fuel. On this question the section is working out subject KO-91 "The Elaboration of a Range of Measures for Cooperation Aimed at Further Fuel Savings in Producing Electric and Thermal Power As Well As Reducing Energy Losses in Networks" and this contains the following subthemes:

1) A range of measures to improve the mentioned equipment in the TETs, including the development of extensive technical research on creating new equipment and organizing production on the basis of specialization and cooperation;

2) A range of measures aimed at fuel savings based on increased efficiency of central heating, including the improvement of design solutions for the TETs and the use of TETs as flexible power plants;

3) Measures related to the renovation and reconstruction of obsolete TETs, including the elaboration of a method to establish the efficiency of replacing and reconstructing the equipment at the obsolete TETs. Catalogs are also to be worked out for the basic equipment which can be used in replacing the obsolete.

In an article it is difficult to describe the extended program under subject KO-91 and all its working subthemes. The designated subthemes, however, show how important the problem of fuel savings is for the TETs.

In the area of scientific and technical cooperation, subjects are being worked out which directly influence the greater dependability and efficiency of the TETs. In this area we could mention the following subjects:

1) An assessment of the conditions (results) from the operation of 200-300-megawatt units from the viewpoint of attaining the parameters, efficiency and reliability;

2) Improving the design decisions and organizing the construction and installation of TETs with large units.

The utilization of slag and ash is also a major problem of great significance for the economic and efficient managing of the TETs. The section is working out the subject PT-02 "The Eoaboration of Methods, Conditions, Technical and Organizational Measures to More Widely Use Ash and Slag from Thermal Plants in the National Economy As Well As the Methods of Separating These Materials and Supplying Them to Various Consumers." This subject contains several interesting subthemes as:

1) An overall plan for the production methods of electric and thermal power in fully utilizing the ash and slag in the national economy;

2) Factors which influence the extended use of ash and slag from the TETs in the national economy.

A solution to the problem of using ash in the national economy can provide a great economic effect and for this reason serious attention is being given to research and experimental work as well as to the exchange of experience.

In addition to the elaboration of the designated subjects, Section 2 is working constantly to increase the efficiency of multilateral cooperation. One of the most complicated problems in operating the TETs is the repair of power equipment. In order to improve the quality of repairs and lower their cost, four concerned nations --the GDR, Poland, the USSR and CSSR--in 1978 signed a protocol on cooperation on subject NT-61.2.3 "Questions of Improving Repairs on High-Capacity Power Units." Within this subject the concerned nations are working out the following subthemes:

1) The compiling of a unified, coordinated terminology in the area of the technology, organization of repairs and maintenance; to be carried out by the USSR;

2) The elaboration of unified technological and organizational repair documents; to be carried out by Poland;

3) The elaboration of a set of computer programs for the software of the network planning system used in the repair of power equipment; to be carried out by the GDR;

4) The elaboration of a unified proposal to assess the quality and effectiveness of repairs; to be carried out by the CSSR.

Each of the enumerated subthemes is to be carried out with the drawing up of technical specifications and the interchange of these is to be carried out in accord with the work plans on the principle of gratis equivalent exchange. This will make it possible for the participating nations to sharply reduce expenses on the elaboration of repair documents and improve the quality of repairs. Here each of the participating nations works out those subthemes in which it is most experienced in comparison with the other partners. In the future there are plans to employ this form of cooperation for solving complex problems in the area of the designing, construction and operation of the TETs.

Another form of work in Section 2 is meetings of specialists where they carry out a thorough analysis of the discussed problems and elaborate specific conclusions and proposals. The extensive exchange of experience among the conference participants makes it possible for them to better understand the problems of operating the TETs in the CEMA countries. The results of such meetings cannot be measured by specific figures but undoubtedly they contribute largely to a greater effect from cooperation. This is reflected in the improving of the operating indicators of the power plants.

In this article it is impossible to enumerate all the work completed by Section 2. The purpose has been to show by several examples the work done by the section as a working body which directs the activities of the CEMA countries in solving the basic problems of operating thermal plants. The goal has been the broad use of experience by the countries in the designing, construction and operation of the TETs. A major contribution of the section has been the strengthening of cooperation and friendship between the power workers of our countries.

In conclusion it must be emphasized that the specialists from Section 2 have had an opportunity to visit a large number of power plants in the CEMA countries, including the Maritsa-Iztok-3 TETs. It is noteworthy that the problems of burning the low-calorific coals in the Maritsa-Iztok-3 have been solved in considering world accomplishments in this area. The high operational level at this power plant and the indicators achieved by it show that the Bulgarian power workers have won significant success. Each of our countries has accomplishments in individual areas of thermal power. The exchange of experience, the use of achievements and the joint elaboration of new problems--all of this is a guarantee for the successful development of power engineering in the CEMA countries. Section 2 has also made a humble contribution to this development.

10272
CSO: 2200/112

ACHIEVEMENTS IN HYDROPOWER DEVELOPMENT REVIEWED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 60-63

[Article by Gheorghe Luka, deputy director of the Institute for Hydropower Research and Designing in Bucharest, Romania, and chairman of Section 3 of the Permanent CEMA Commission for Coopeation in the Power Engineering Area: "New Effective Decisions in Hydropower Construction of VETs and PAVETs"]

[Text] The CEMA countries possess great hydropower resources and they cover a portion of the national economic energy requirements.

In all the CEMA countries particularly great attention is given to an evaluation of these resources. The questions of resource evaluation, in being posed in the construction of hydropower installations, are complex and the solution to them in many instances necessitates cooperation between the CEMA countries in the technical, scientific and economic area.

The Permanent CEMA Commission for Power Engineering has assisted in the organized development of this collaboration. For more than 20 years within the commission Section 3 for hydropower plants (VETs) has been active as a working body.

The section has undertaken extensive activities to collaborate with specialists from the CEMA countries in the area of research and study, design, construction and operation of combined hydropower and hydraulic engineering facilities. These activities have provided an opportunity to generalize the experience acquired in the individual countries. The use of the decisions and conclusions made in the generalized reports under the section involving specialists from all the countries has helped to achieve new effective decisions in the building of the VETs and the combined hydraulic engineering installations.

An assessment has been made of the hydropower resources which the CEMA countries possess and the dynamics of their use. On the basis of the final analysis made in 1980, it can be concluded that the CEMA countries possess significant hydropower potential. By 1978 the use factor of this potential was very great with a tendency for a sharp rise over the long run (by 1985). The corresponding data are given in the table.

Country	Технически хидроенергиен потенциал (ТХЕП), GWh/год 1	Произведена електроенергия във ВЕЦ през 1978 г. ($E_{ВЕЦ}$), GWh/год 2	Обща произведена електроенергия през 1978 г. E_Σ, GWh/год 3	Хидроенергиен потенциал, планиран за използуване през 1985 г. (ХЕП), GWh/год 4	$\frac{THPP}{E_\Sigma}$, %	$\frac{E_{VETs}}{E_\Sigma}$, %	$\frac{E_{VETs}}{THPP}$ %	$\frac{HPP}{THPP}$ %
Bulg.	12130	2646	31492	3670	38,5	8,4	21,8	30,3
Hung.	5200	136	25556	230	20,3	0,5	2,6	4,4
GDR	700	240	95963	280	0,73	0,25	34,3	40,0
Pol.	12080	1951	115557	1800	10,9	1,7	16,1	14,9
Rom.	40000	10613	64230	16030	62,3	16,5	26,5	40,0
USSR[1]	75100	18000	—	18190	—	—	23,9	24,2
CSSR	9020	3527	69097	3560	13,1	5,1	39,2	39,5

[1] For the USSR, the potential has been given for the territories of the Northwestern and Southern UPS which directly border the European CEMA countries.

Key: 1--Technical hydropower potential (THPP), gigawatt hours per year; 2--Produced electric power at VETs in 1978 (E_{VETs}), gigawatt hours per year; 3--Total produced electric power in 1978, E_Σ, gigawatt hours per year; 4--Hydropower potential planned for use in 1985 (HPP), gigawatt hours per year.

In the CEMA countries where the amount of hydropower resources is insignificant (for example, the GDR and Poland), PAVETs [pumping and storage hydropower plants] with a total capacity of around 3,000 megawatts are employed to cover the peak areas of the load schedule. In the future there are plans to increase this capacity by around 12,000 megawatts and some of the planned PAVETs will be built by joint efforts of the concerned CEMA countries.

The activities of Section 3 have developed and will continue to develop in the future under favorable conditions which are the result of the particular concern both previously and at present by each CEMA country to tap its hydropower potential.

In recent years the section's activities have been focused on research in the following areas:

1) Optimizing the use, operation and control of the PAVETs and VETs;

2) The establishing and designing of plans for hydropower projects under construction;

3) Production and methods of using new efficient materials for hydropower construction;

4) Protecting the environment which could be influenced by the construction and operation of hydropower projects.

The article gives some of the important results and conclusions from the generalized reports elaborated and examined in the section and which should be particularly emphasized.

In the area of the rational utilization of hydropower resources and the feasibility studies for the construction of VETs and PAVETs, all the basic prerequisites have been examined necessary for assessing the technical and economic efficiency of hydropower projects. Critical methods used in the CEMA countries for determining efficiency were examined and the more general nature of a method to compare conventional alternatives was outlined.

The urgent questions involving construction of PAVETs which are to be built by the joint efforts of the involved countries have shown the necessity of elaborating uniform criteria for assessing the technical and economic effectiveness of these projects.

In line with the efficiency of PAVETs, it must be pointed out that the electric power systems of the individual countries will be developed mainly through the construction of base TETs operating on low-grade solid fuel as well as nuclear power plants. Under these conditions the building of PAVETs with the above-indicated installed capacity will ensure a more even loading of the TETs and AETs and will reduce the necessity of building new peak and reserve capacity operating on gas and mazut.

At present, as in the future, a predominant portion of the VETs built in the CEMA countries are to be part of complicated hydraulic engineering systems involving multiple use. The requirements for the different functions of these systems (energy, water supply, irrigation, water transport and so forth) are at times contradictory and this necessitates the search for common optimum solutions in the economy of each country. Because of this the questions of optimizing the operating conditions of the VETs as part of multi-use projects, under the conditions of the increasing deficit both in the thermal power balance and for water resources, have been the subject of profound basic research in the CEMA countries to create mathematical models for the multiyear optimizing of conditions.

The necessary measures have been examined for improving the flexibility and reliability of the peak VETs and PAVETs which, due to these qualities, play an important regulating role within the electric power system of each country. For the utilization of fast-acting reserve capacity in the reservoirs, a reserve volume is provided for and for the PAVETs this must provide an opportunity to work at a nominal capacity for approximately 1 hour. Reserve capacity for frequency regulation is 10-20 percent.

In designing large-capacity peak plants, it has been recommended that there be the simultaneous starting up of all the units with the use of the independent internal energy source for own needs.

The equipment in the primary plan of a PAVETs must be capable of withstanding a large number of daily operations.

The availability factor of the VETs and PAVETs in the CEMA countries is on the order of 0.97. This is a very high indicator and for further improving it it is essential to utilize high-quality materials in producing the equipment and an optimum organization of repairs.

The dependability of the VETs and PAVETs in carrying out the above-indicated functions depends generally upon the reliability of the turbines, generators and auxiliary equipment and the automatic and control systems. In this area in the Section technical conditions have been worked out which must be taken into consideration in the production, designing and building of VETs equipment, in the specific equipment for the PAVETs as well as the special electrical equipment characterized by a large number of switchings and operations in a 24-hour period.

The automating of hydropower equipment is also an important factor in increasing its efficiency. It can be considered that in the CEMA countries the automating of hydropower facilities is on a world level.

The automation systems must be improved by utilizing modern elements such as highly reliable sensors for nonelectrical values and automatic devices based upon the contactless logical circuits and computers.

For the control and monitoring of series of VETs, it has been recommended that use be made of automatic control systems employing computers for the long- and short-term hydrological forecasts and forecasts of consumption conditions as well as automatic optimization of the operating conditions in the series. In this regard it is essential first of all to set up an improved information system for the series of plants.

For the purpose of improving designs in the construction of hydropower projects, the section has studied certain particularly important problems which are of significant interest at present. These are:

1) Stress strain in massive concrete hydropower installations;

2) The influence of dynamic effects on the stress and strain state and strength (particularly seismic strength) of reservoir walls and other installations;

3) The bases of design decisions for the lining of pressurized hydraulic engineering tunnels built under various geological conditions.

In studying the stress in massive hydraulic engineering works in Bulgaria, Hungary, the GDR, Poland, Romania, the USSR and CSSR, methods and algorithms were worked out for computer calculation based on modern mathematical methods. Among these one should note the method of extreme elements for flat and spatial problems. Also improved were the methods for determining basic data, in particular, the geotechnical characteristics of bedrock by laboratory testing and testing of real objects.

For the more important projects in the designated nations, mathematical research was supplemented by laboratory research on structural and photographic models. The employed similarity criteria as well as the materials and methods of modeling made it possible to model the particular features of the bedrock (continuity and anisotropy) as well as to examine certain structural features (expansion, joints, large-sized openings in relation to the width range of force).

In all the CEMA countries, particular attention has been given to observations of the static behavior in operating hydraulic engineering installations using monitoring and metering equipment built into the project.

Comparisons of the stresses and strains determined in measuring real projects with those obtained theoretically or by model testing have made it possible to assess the safety of the structures and reassess the accepted hypotheses and initial data.

We must note the activities in testing the monitoring and metering devices produced in certain CEMA countries (Poland, the GDR, Romania, the USSR and CSSR) and installed in the underground Markersbach plant in the GDR and the arched concrete wall in Dregan (Romania). In the future the work of this equipment will be monitored by measurements performed jointly by the specialists from the interested nations.

The influence of dynamic effects on the structure of water-saturated rock and hydraulic engineering works made from local materials (ballast and earthen embankments) and the corresponding mechanism of diluting the unbonded particles and increasing the pressure in macroporous materials has been studied in most of the CEMA countries both theoretical, using the method of extreme elements for flat problems as well as by experimental research under laboratory conditions and on real projects. We have determined chiefly the basic data and critical values of parameters characterizing the state of stresses and strains (the maximum degree of pressure, the physico-mechanical characteristics, acceleration in the propagation of dynamic waves, porosity, resistance to shear slippage and specific strains).

The following method was adopted for determining stability with the dynamic action of macroporous and water-saturated unbonded structures:

1) Calculating in a two-dimensional scheme the effective static and quasidynamic forces;

2) Experimental research of the strength of the structure using equipment making it possible to conduct dynamic research;

3) A dynamic testing (the appearance of super stresses in the pores and diluting) by a comparison with the values of critical parameters;

4) The use when necessary of consolidation theory in determining a superpressure in the pores.

The seismic strength of large reservoir walls made from local earth materials (ballast and stone) was examined both from the viewpoint of the intrinsic dynamic characteristics of the structures as well as from the viewpoint of the slope strength using the linear-spectral method for determining the additional loads represented as static forces.

The seisemic strength of concrete dam walls was studied mainly on the basis of the theory of spectral analysis considering the interaction with the foundation in thus rejecting the hypothesis that the foundation is the rigid element which does not oscillate along with the structure.

The next stage in studying the seismic strength of dam walls will be the application of a dynamic method using accelerograms (recordings of real earthquakes) considering the real conditions in the propagation of the seismic waves, the tectonic continuity, the nonlinear (plastic) properties of the soil and the interaction with the reservoir.

The stress in the lining of underground structures having a noncircular contour and in the surrounding rock was studied in Bulgaria, the GDR, the CSSR, USSR and Yugoslavia using the extreme elements method. With the same method for a spatial problem, a study was made of the uneven contour of the excavated profile in relation to the static behavior of linings in circular pressurized galleries in establishing the reserve resistance due to the cross-digging. This conclusion was confirmed by special testing carried out on structural models. With the help of an analytical method, a study was made on the thermoelastic state in the lining and enclosing rock under the condition of fixed and variable temperatures in bearing in mind the rock cracks. Here the reserve resistance was established in comparison with the calculated temperature differences between the internal and external surfaces and particularly in the case of metal linings.

The stress in cite-cast linings which were prestressed by injection was studied in the above-mentioned nations using an analytical method, considering the factors influencing the residual effect of prestressing, that is, the slippage of the rock and the lining, the laying of the concrete, cracks and permeability of the rock. Criteria were set for determining the parameters and other technical elements in making injections which have a pressure action.

The use of light, crack-prone concrete coverings under certain operational conditions (free flow, water-permeable soils or compacting by the injection of cement) was established both theoretically as well as by experimental research in establishing the cracking limits depending upon the operating conditions and the class of structure.

In the area of efficient materials and manufacturing technologies, a study was made of the problems related to the use of asphalt concretes, polymer materials, anticorrosion protection, wear and cavitation-resistant materials for injection and the compacting of the foundations of hydraulic engineering projects.

Asphalt concretes are gaining ever-wider use for the masks and screens in compacting dam walls as well as for lining canals and storage basins. Recommendations were studied in engineering terms and adopted for the quality of the bitumen and auxiliary materials, the composition of solvents, the conditions for preparation and use, the layering of the masks and screens, quality control and observation during use. The conclusions are based on a large number of experimental and laboratory studies as well as studies on real projects.

The use of polymer materials for the hydrosealing layers in compacting canals and dam walls was examined under laboratory conditions for resistance against microorganisms, for aging, the effect of the freezing of water and the thawing of ice, as well as for installment and use.

A procedure was established for the required laboratory testing to select cavitation-resistant synthetic materials as well as admixtures to increase the cavitation and erosion resistance of the concretes.

New polymer products, epoxy resins and zinc-based paints were studied for use as anticorrosion protection and these make it possible to lengthen the life of metal structures by 10-12 years.

Using electron microscopy a study was made on the structure of the classic compacting materials (cement, clay and bentonite).

Also studied were effective solutions with an admixture of ash from the TETs and a broad range of sealing substances (silicates, furfurol, epoxy resins and polyester resins). Recommendations were worked out to use injection materials and injection technique under different geological and operating conditions.

Generally speaking the hydraulic engineering structures have a beneficial impact on the environment, in helping to improve the microclimate, to develop underwater fauna and they make it possible to avoid the inundating of certain areas and reduce flood losses. At the same time, the morphological change in the channel and the subsoil water conditions, as a consequence of constructing the hydraulic engineering works, can have a negative impact on the environment.

In this area, Bulgaria, Hungary, Poland, Romania and the USSR have made studies on the head water and under water of the VETs in determining the conditions whereby erosion or the depositing of silt occurred creating a danger for the surrounding terrain and specific measures were recommended to combat these phenomena.

Studies were also run on the changes which occur in under water currents in building reservoirs and recommendations have been worked out for compacting and drainage systems of levees and walls.

It is essential to emphasize that all these results and conclusions can be used in the study, designing, construction and operation of hydraulic engineering works in any CEMA country. Due to this, the activities of the specialists in the section contribute to the finding and application of new effective solutions in the construction of hydropower and multipurpose hydropower works.

The research carried out up to now and the prospects for utilizing the hydropower potential of the CEMA countries determine the areas of scientific and technical cooperation in the immediate future for the CEMA countries and Yugoslavia in the area of hydropower engineering. Section 3 will examine a number of problems necessitating cooperation in their elaboration and the basic ones involve the following areas:

1) The rational use of hydropower resources as part of multipurpose water management systems, including the use of the hydropower micropotential;

2) The operation of power equipment at the VETs and PAVETs and its automation and remote control;

3) Research on the behavior of the hydropower equipment by using advanced devices for measuring, transmitting, centralized recording and direct data processing in the aim of increasing their reliability and progressiveness;

4) The seismic resistance of massive hydraulic engineering structures under the conditions of economic effectiveness and the elaboration of a modeling method with increased reliability for the phenomena of the mathematical and structural models for determining the basic initial data, in particular of the accelerograms and the elaboration of recommendations on the practical calculations of such structures in a seismic area;

5) The mechanizing of construction for dam walls and underground structures using highly productive equipment and effective materials;

6) The materials and technologies for compacting as well as protection against corrosion, cavitation and erosion.

Cooperation among the CEMA specialists in the area of hydropower engineering in solving the designated problems will contribute to increased effectiveness in solving the questions related to providing power for the national economies of the countries.

10272
CSO: 2200/112

CEMA RESEARCH PROJECTS IN POWER AREA DESCRIBED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 64-67

[Article by Josef Fisher, director of the Scientific Research Institute for Power Engineering in Prague, CSSR, and chairman of Section 4 of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "Basic Directions in the Development of Scientific and Technical Cooperation Within Section 4 for Coordinating Scientific Research of the CEMA Countries"]

[Text] In accord with the deepening of socialist economic integration and the development of the scientific and technical revolution, greater and greater importance is being given to international cooperation in the area of developing and improving the power systems of the CEMA countries.

For the purposes of planned cooperation among the socialist countries in the area of electric power, in 1956 the Permanent CEMA Commission for Power Engineering [PCCPEA] was set up with permanent working bodies consisting of five sections, the MOSNTI [International Sectorial System for Scientific and Technical Information] and an editorial staff for the bulletin of the PCCPEA.

The basic areas of activity for the section to coordinate scientific research have consisted in the elaborating of problems in the area of electric power and central heating and primarily in solving the urgent and long-range questions which were of common interest, for achieving maximum effectiveness from the scientific research, for avoiding parallel work, and for more fully utilizing the research results in the practice of the individual CEMA countries. The task of Section 4 has been to promptly provide modern and high-quality solutions to the theoretical and procedural questions related to the operation of the power systems in accord with the development of the entire sector.

Participating in the work of Section 4 of the PCCPEA are the basic scientific research and design institutes of the CEMA countries in the area of power engineering.

Scientific and technical cooperation among the CEMA nations in Section 4 during the period of 1976-1980 has been carried out in accord with the established plan to solve the following basic tasks:

1) The procedural and theoretical problems in the long-range development and integration of the unified power systems (UPS) of the CEMA countries;

2) The principles and means for controlling the operational conditions of the UPS for the purpose of their development and technical progress;

3) The questions of building and operating TETs and AETs in relation to their role in the UPS;

4) The questions of building and operating VETs and PAVETs;

5) The development and operation of power transmission lines under the conditions of the UPS;

6) Questions of protecting nature and the environment in the designing, construction and operation of power projects.

The article gives several examples of effective multilateral cooperation within the extensive activities of Section 4, mainly in the area of solving problems of a systems nature.

The need to work out the subject "Research on the Technical and Economic Bases in the Development Strategy of the CEMA UPS" (subject NO-61.1) arose with the request to work out the basic procedural problems related to the extending of socialist integration in electric power with the further development of the unification and interaction of the power systems and the search for the means (mathematical models) to solve certain specific problems relating to the development of the UPS.

This subject also settled the question of the rational relative share of the peak regulating power plants in the power systems of the CEMA nations. It was established that in countries with favorable geomorphological conditions the PAVETs are the basic type of flexible generating sources and their use provides a maximum technical and economic effect. Under favorable conditions and available technology it was also recommended to build semipeak TETs or units with a combined steam-gas cycle. The specific research on the development of the CEMA power systems has shown that by 1990 each of the participating power systems will be capable of satisfying its needs from the generating capacity to cover the peak and semipeak load. The peak generating capacity of the CEMA countries by 1990 will average 7-10 percent of the total installed capacity.

Further research was aimed at solving the questions of the reliability of the UPS cooperating within the association as well as the questions related to the joint use of the emergency reserve and the intersystem capacity essential for this cooperation. The main results in this area are of a procedural nature.

At present, the results of the work on the subject have still not produced a direct economic effect, but still they create the prerequisites for the further use of the effects which are obtained as a result of the unification of the CEMA power systems. In bearing in mind the nature of the problems which require cooperation by all the participating countries, the research carried out by each individual nation is not sufficient.

At the same time active participation in the joint coordinated research broadens the range of knowledge used by the participating countries and complements their procedural materials relating to the reliability of the electric power systems.

The subject "Draft Procedure for Implementing the Existing Intersystem Effect from the Unifying of the Daily Load Schedules of the CEMA UPS at the CDA [Central Dispatching Administration]" (subject KO-84) was incorporated in the research coordination plan of Section 4 with the necessity of deepening the multilateral interaction of the CEMA UPS participating in the Central Dispatching Administration. The aim of the subject is to work out a specific draft procedure for realizing an intersystem effect from combining the daily load schedules of the UPS. This arises as a result of unifying the power systems of Bulgaria, Hungary, the GDR, Poland, Romania and the CSSR over the 400-kilovolt intersystem links.

The use of this effect was not established with sufficient effectiveness and was not based on contractual principles.

Within the coordinated research, a draft was proposed for a procedure which on the basis of the comments of the CEMA countries was worked up and backed up with specific technical and economic calculations. The method complemented an analogous procedure for multilateral cooperation in using the effect which was obtained in unifying the UPS and the Joint Power System of the USSR (USSR JPS) by a 750-kilovolt link. The proposed method offered cooperation on the zero-balance principle, it envisaged the possibility of broadening the coordinating function of the CDA and provided a savings and more efficient use of the peak load of the UPS at an amount of around 500 megawatts.

The draft procedure was adopted by the PCCPEA and turned over for practical implementation to the CDA of the joint power systems which at present is settling the problem of the principles of implementation. The proposed measures do not require additional capital investments. It is merely a question of providing effective daily coordination of the UPS operating conditions.

The work on the subject "Research on the Hierarchical Structure of Dispatching Control and the Questions of Setting Up and Introducing Automated Dispatching Control Systems (ASDU) in the UPS" (subject NO-62.1) was started in 1976, when great attention was given to the exchange of information on the achieved stage in the work of the individual participating countries. With the aid of questionnaires and the subsequent processing of the obtained data, an analysis was made of the following problems of the ASDU:

1) The methods and algorithms for long- and short-term planning and control of the power systems in the real time for the needs of the state dispatching administrations;

2) The elaboration of coordinated technical and economic criteria for optimizing the operating conditions of the CEMA UPS;

3) The generalizing of experience of the individual countries in introducing the ASDU into service on the level of the state dispatching administration;

4) The methods for determining the reliability of data used in the ASDU.

Significant attention was also given to the working out of statistical methods to determine the parameters of the power systems for the needs of the ASDU on the level of the UPS. These methods which at first were used to determine the capacity frequency coefficients were tested out experimentally in 1977 by measuring the operating parameters and upon the request of the CDA directorate, in 1979 repeated measurements were carried out but now under the condition of the parallel operation of the CPA UPS and the USSR JPS over the first 750-kilovolt intersystem link. The basic advantage of determining the capacity frequency coefficients using statistical methods consists in the possibility of determining them without interfering in the normal operations of the UPS in contrast to the previously used methods with the introduction of artificial intermittent interference in the active power balance.

In recent years, on the basis of the acquired experience, an overall concept was worked out for the further development of the UPS ASDU for the period after 1990. This concept was worked out in close cooperation with the CDA Directorate and was approved by its executive bodies. The concept outlines the individual functions of the UPS ASDU which are delimited by time and operating conditions, it gives an assessment of the used and future software structure and in conclusion formulates the basic requirements and gives recommendations on the optimum equipment structure for actual implementation.

In spite of the fact that the work on the subject was aimed predominantly at application in the area of UPS control, the obtained results can also be employed in solving the problems of the ASDU for the power systems of the individual CEMA countries.

The benefit from such a study consists chiefly in providing parallel interaction of the CEMA power systems, particularly after completing the first 750-kilovolt intersystem link with parallel operation of the CDA UPS and the USSR JPS.

For the subject "Research on Control Methods and Algorithms" (subject No-62.2), cooperation was concentrated on elaborating the questions of automatic frequency and exchange capacity control systems (AFCCS).

On the basis of the experience from an experimental check of controlling the power systems using control computers supplemented by the results of calculating the dynamic properties by modeling, an analysis was run on the basic rules for designing the AFCCS chiefly from the viewpoint of utilizing digital control. This analysis was further supplemented by research on the adaptive principles for controlling frequency and exchange capacity and these were the most promising in the search for dependable operation of the participating power systems under the conditions of limited transmission capacity for the domestic and intersystem power lines.

The elaborated material can serve as the basis for working out the ASDU programs on the level of the UPS CDA. Its significance consists above all in ensuring dependable operation of the UPS, including a rise in the quality of maintaining the nominal frequency in the network.

The delegations from the CSSR, GDR and Cuba jointly worked out the concept for creating the ASDU for the Cuban power system. This employed the existing experience from realizing the control systems for the highly developed power systems considering the experience of introducing the ASDU under Cuban conditions. The elaborated material will be used by the dispatching control bodies of Cuba as a source of initial data for creating the ASDU, for understanding the possibilities of using the existing control programs and algorithms as well as in designing the first stage of their own ASDU.

On the subject "Improving the Controllability and Reliability of Power Plants in the UPS" (subject NO-3.6), the research was focused on studying recovery systems with large steam turbines and the elaboration of technical recommendations for their optimizing.

The results provide an opportunity for the design organizations and operational groups to use progressive solutions in improving the control systems and raising the flexibility of the newly built and in-operation power units.

Further cooperation was carried out in experimental research on the dynamic characteristics of the new power units. The results of this research can be used as supplementary data for increasing efficiency and optimization in operating the new units. Research on the models of dynamic characteristics aimed primarily at the behavior of the units with a change in the load in starting up, shutting down, adjustment and so forth is valuable input information for subsequent research on rationalizing the operations of the power plants.

Theoretical research on the reliability of the main assemblies of power units is a contribution in the area of procedural research on the duration of the operating life of these assemblies. This helps to deepen the methods of determining reliability indicators. The technical requirements for the operational maneuverability of the semipeak units at the TETs are specific aggregate requirements for the high-powered units in producing the base and semipeak energy. The reports on the individual parts of the subject, after their approval by the PCCPEA, were turned over to the Permanent CEMA Committee for Machine Building and the appropriate bodies of the CEMA countries for use.

Scientific and technical cooperation in the area of the construction and operation of power networks under UPS conditions (subject NS-61) has been aimed at studying the conditions for voltage regulation and compensating for reactive power in the networks as well as at studying the corona losses and radio disturbances from the super-high voltage networks.

The obtained results have helped to improve the quality of electrical network planning and better the methods for choosing the design of the power lines, and particularly the super-high voltage lines.

In the area of environmental conservation, Section 4 has worked on the subject "Research on Measures to Restrict the Ecological Influences of Power Lines in the High-Voltage Networks" (subject NM-61). The final report contains conclusions and recommendations relating to restricting the influence of the electrical field on people and the environment. A table has been worked out with normalized values for the intensity of the electrical field and currents as well as a recommendation on calculating the intensity level of the electrical field and optimizing the design of the power lines.

A positive factor in collaboration has been primarily the generalizing of opinions on the basic requirements for determining and establishing the choice of tolerable intensity levels for the electrical field. Collaboration has provided a saving in the exchange of research by the participating nations and has made it possible to accelerate the publishing of instructions, recommendations and other normative materials.

Section 4 has also participated in solving problem 1-11 "The Development and Construction of Experimental Sections of Superconductive and Cryoresistive Power Lines and the Prototypes of Electrical Equipment with Superconductive Winding." This has been included in the contractual plan on multilateral integration measures for the subject "Research in the Area of the Rational Use of Superconductive and Cryoresistive Power Lines and the Technical and Economic Calculations for Them."

In elaborating this subject, there was a discussion of the technical and economic aspects of power supply for large cities and industrial conglomerations and the questions of exporting capacity from large power plants. The basic concepts and development trends were established in superconductive cables. An analysis was made of the questions relating to the choice of the technical and economic criteria for assessing the efficiency of superconductor power lines. This determines the choice of the parameters for the individual elements of superconductive cables. In addition, as an example, a calculation was made for the efficiency of different versions of superconductive power lines 100-500 km long in the power systems of the individual countries comprising the UPS.

From the given examples one can see the contribution of the scientific research carried out by Section 4 predominantly in the area of research and procedures which ensure the prospects of coordinated research and the development of technical areas in power engineering. An additional positive factor is the experimental research and testing which is carried out by the research organizations of all the CEMA countries participating in the work of Section 4. In addition, an opportunity has been created in the Section to exchange information on the promising directions and long-term trends between the individual coworkers of the scientific research institutes and organizations. Due to this, a close mutual tie has been established between the problems being solved by the PCCPEA in the process of the on-going development of science and technology.

The systematic theoretical, procedural and experimental activities of Section 4 have been a direct contribution in solving the high-priority problems of the PCCPEA and its results serve directly as initial data in the practical use of the studies in the other sections of the PCCPEA and in the corresponding CEMA working bodies, the international organizations (for example, the CDA) and in the energy sectors of the individual CEMA countries.

The scientific and technical research of Section 4 in the forthcoming 5-year period of 1981-1985 in its main areas is directly tied to the studies carried out in the past five-year plan.

Chief attention is focused on carrying out the requirements and tasks outlined in the basic materials of the appropriate CEMA bodies in the power engineering area. These ensure the elaboration of the long-range subjects for achieving an economic effect in the CEMA countries.

The adopted "Plan for Cooperation Among the CEMA Countries in Conducting Scientific and Technical Research of Mutual Interest in the Area of Power Engineering in 1981-1985" is the basis for carrying out the multilateral cooperation.

The draft of this plan was worked out with the cooperation of Section 4 and the power engineering department of the CEMA Secretariat and was approved by the 55th PCCPEA Session. The plan primarily ensures the carrying out of the high-priority tasks stemming from the Comprehensive Program for the further deepening and improving of collaboration and the development of socialist economic integration of the CEMA countries as well as the other approved CEMA documents in the power engineering area. These documents are:

1) A long-range specific cooperation program in satisfying the economically sound needs for the main types of energy, fuels and raw materials of the CEMA countries up to 1990 (in the area related to power engineering);

2) A coordinated plan for multilateral integration measures of the CEMA countries (relating to power engineering);

3) A coopeation treaty for the long-range development of the CEMA UPS up to the year 1990.

The cooperation plan for scientific research can be divided into the following areas:

The optimizing and feasibility studies for the long-range development of the CEMA UPS, the elaboration of scientific procedural recommendations, the studying of the most rational variations for the development of the power systems (the capacity structure of the power plants, of the electrical networks, the long-range operating conditions of the power systems, the program and data systems for analyzing the development variations of the power plants and electrical networks and for optimizing capital investments into the development of the power systems). The procedure will be improved for selecting the most rational variations for the configuration of the electric networks and the intersystem links (subject I NO-11.1).

The construction of the intersystem 750-kilovolt power lines and the strengthening of the 400-kilovolt links has led to the formation of a number of self-contained contours (ring links) and this requires that the general research be focused on elaborating a coordinated system for automatic control of frequency, voltage, active and reactive capacity in the power lines of the UPS and power systems of the CDA member nations. The use of computers for the ASDU in the individual countries and the CDA makes it possible to automate the above-mentioned functions. Methods, algorithms and programs will be worked out for direct numerical control based on the use of third-generation computers and standardized equipment for discrete automatic control (subject NO-12.1).

The procedural and scientific-technical questions relating to the further development of the ASDU under the conditions of the intensely developing UPS will also be aimed at elaborating more advanced complexes of measures to improve the dependability and technical-economic efficiency of the operational and dispatching control of the UPS and of the information system both under normal and emergency conditions (subject NO-12.2).

In the area of the construction and operation of TETs, research will be aimed at developing the large power units and increasing their reliability, efficiency and controllability. Modern methods will be worked out for the technical diagnostics for dependability in the most important assemblies of power equipment at the power plants for the purpose of preventing emergencies and extending the operational life of power equipment. At the same time, we will work out and introduce deaerator-free recovery systems for turbines at the TETs and AETs as well as combined-type heaters. In addition to this, cooperation will be aimed at elaborating progressive methods for preparing and intensifying the combustion processes for the low-calorific solid fuels in the aim of increasing fuel combustion efficiency and increasing the efficiency of the TETs (subject NT-12).

Scientific and technical research in the area of central heating will be aimed at working out measures to increase the reliability and economicness of central heating and central heating supply as well as at building large central heating systems, including the transmission of thermal energy over long distances and the storing of thermal energy (subject NT-12).

In the area of electric power networks, scientific and technical cooperation will be aimed at investigating the questions of developing the system-forming networks of the CEMA UPS in terms of the conditions for short circuit currents in the major junctions of the network over the long-range period. In addition, research and development will be carried out on safety systems against system-generated overvoltage and the choice of the test voltages for the 400- and 750-kilovolt lines and equipment in the future period as well as research on the influence of meteorological factors and freezing of insulating on the dependable operation of power networks (subject NS-11).

The cooperation plan has been adjusted and concretized at sessions of the individual sections and at sessions of the commission. On the basis of the plan, after this, detailed working plans were elaborated for the individual subjects for which all important scientific and technical questions of mutual interest will be solved. The higher forms of cooperation will be more widely introduced, primarily, the concluding of contracts and agreements.

The responsible approach of the delegations from all the participating countries to carrying out the tasks outlined in the detailed working plans for coordinating research on the individual subjects is an essential condition for successfully carrying out the following stage of multilateral scientific and technical cooperation among the CEMA countries in the area of electric and thermal power engineering.

10272
CSO: 2200/112

CEMA COOPERATION IN NUCLEAR POWER ENGINEERING OUTLINED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 67-70

[Article by Fedor Ya. Ovchinnikov, Soviet deputy minister of power and electrification and chairman of Section 5 of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "Cooperation of the CEMA Countries in the Area of Nuclear Power and Its Development Prospects"]

[Text] On 13 June 1980, in the city of Hradec Kralove, CSSR, an agreement was signed on multilateral cooperation among the CEMA countries in scientific research and design work on the problem "Developing Power Units with Water-Moderated Reactors and a Capacity of 1,000 Megawatts and the Further Improvement of This Type of Reactors." The signing of this agreement was preceded by extensive preparatory work by the CEMA countries, the CEMA Secretariat and the international economic association Interatomenergo [International Nuclear Power] in elucidating the most urgent questions related to the construction and operation of nuclear power units with VVER-1000 reactors.

To a large degree this agreement was the result of years of experience in fruitful joint work by the nations of the socialist commonwealth in the area of nuclear engineering. Without this the setting up of such a comprehensive, all-encompassing program would have been impossible.

The start of this joint work was made in the second half of 1967, when under the Permanent CEMA Commission for Cooperation in the Power Engineering Area [PCCPEA] Section 5 was set up designed specially to coordinate and organize the use of nuclear power for the purposes of electrification and heat supply.

At that time, in the countries of the socialist commonwealth there was only one nuclear power plant in operation. This had been built with Soviet technical assistance and was the pioneer in the area of the peaceful use of nuclear power. This was the Rheinsberg AETs in the GDR. Its capacity was small, some 70 megawatts. But construction had already commenced on powerful nuclear power units in the GDR and CSSR. Thus, on the agenda was the question of creating a coordinating center which would provide for effective cooperation in the nuclear engineering area. Section 5 of the PCCPEA became precisely such a center.

The work of Section 5 has been directed at deepening scientific and technical cooperation among the CEMA countries in the area of nuclear power by concentrating efforts on solving urgent problems in the design, construction, safety, the creation of special equipment and the operation of the AETs.

In defining the specific problems for the first period of activities by Section 5, they proceeded from the advisability of the joint elaboration of primarily the questions of the greatest interest and the greatest timeliness for the CEMA countries, considering the fact here that certain of these countries had actually begun to build AETs whild others were carefully studying this problem.

According to the recommendations of the CEMA Executive Committee and the proposals from the CEMA countries, the Section organized the elaboration of a number of subjects representing the greatest practical interest.

A detailed description was made of the basic equipment at the AETs having water-moderated reactors and an electric capacity of 440 megawatts as well as data on their basic technical specifications. The description of the basic equipment for this nuclear power unit was drawn up by Soviet organizations on the basis of materials from the designs of the specific AETs with this type of reactor.

At the insistance of all the countries, an approximate description was also drawn up for the basic equipment for the nuclear power unit having a water-moderated 1,000-megawatt reactor with data on the preliminary specifications, as this was of great practical interest for all the CEMA countries. The description provided a full notion of the composition and technical specifications of the power units for AETs having water-moderated reactors of 400 and 1,000 megawatts. This was also of great practical significance as a basis for cooperation among the CEMA countries in producing the equipment for the AETs and was considered at the Permanent CEMA Commission for Machine Building.

For determining the technical and economic indicators the GDR delegation worked out a "Procedure for Determining the Basic Technical and Economic Indicators of Nuclear Power Plants." The procedure was worked out in order to standardize the calculating of technical and economic indicators and to determine the effectiveness of building AETs in the CEMA countries.

The classification of losses and the individual concepts given in the procedure were to help in mutual understanding and a uniform interpretation in carrying out the calculations and in discussing questions of economicness. The procedure was recommended for use by all the CEMA countries in making economic calculations and comparisons.

For the normal operation of the AETs and for dependable power supply it was essential to work out the rules which would regulate the operation of nuclear power plants. These rules were worked out in Section 5 by Soviet specialists considering their own and foreign experience in operating existing nuclear power plants. Here consideration was given to the enormous experience in operating TETs. The "Basic Principles for Compiling Technical Operating Rules" drawn up by Soviet specialists were recommended as the basis for elaborating the corresponding rules in the individual CEMA countries in accord with their national features.

In Section 5 an important job was the elaborating of the "General Principles for AETs Reliability and Safety." In line with the construction of industrial AETs, it was essential to work out first of all the general safety requirements for the AETs based upon uniform principles which would regulate the designing of the AETs, the procedure for accepting them for operation, the ensuring of safety in the process of operation and so forth.

The general principles prepared by Section 5 served as initial material for elaborating the general principles in the individual CEMA countries. For the exchange of experience in the construction, starting up, adjustment and operation of AETs, the Section has worked out materials on the starting up of blocks III and IV at the Novovoronezhskaya AETs, the A-I Bohunice AETs, the Kozloduy AETs and the Kola AETs. These materials provide brief descriptions of the equipment and systems, an analysis of the organization of construction at the plants, a description of the basic stages in the preliminary starting-up work, the reaching of capacity and the comprehensive testing of the units at rated power. Recommendations were given to reduce the time for starting up the AETs having serially-produced VVER-440 units.

The section has done regular work on exchanging experience in hearing and discussing at its sessions papers by specialists from the individual countries on the basic questions of building, starting up and operating the AETs and containing information on experience acquired in this area during the period between the section's sessions. Such an exchange of information is particularly valuable for all the CEMA members which are building and operating AETs.

The large scale and growth rate of nuclear power in the CEMA countries as outlined in the plans for the 1980's require a thorough study and elaboration of the basic ways for the development of nuclear power during this period. In this sense the Section is already carrying out definite work. The technical and economic calculations made and the operational practice of the AETs have confirmed the advisability and high effectiveness of introducing nuclear power in many CEMA nations. The AETs, however, require extremely large capital investments mainly due to the expensive equipment. A reduction in the cost of this equipment can be achieved most effectively by increasing the unit capacity both of the individual elements and the power units as a whole.

Considering this, the proposals worked out by Section 5 to quickly introduce high-capacity power reactors are of important significance for the development of nuclear power in the CEMA nations. In preparing these proposals, we studied the possibilities of rapidly designing and building AETs with water-moderated reactors of 1,000 megawatts. As a result of this, an all-encompassing program was created for introducing nuclear power units with VVER-1000 reactors.

Of great importance for the development of such power units is the development of new progressive methods to fabricate structural elements, provide protection against corrosion, use new materials, equipment and so forth. The program elaborated by Section 5 for the rapid designing and building of AETs with the VVER-1000 reactors envisages the carrying out of work primarily on these and other most urgent problems related to the creation of high power units for the AETs.

In particular the basic technical requirements have been worked out for the first series of AETs with the VVER-1000 reactors. These determine the basic normative documents for the development, construction and operation of the AETs. Recommendations have been prepared for the starting up work at the AETs with VVER-1000 reactors. The recommendations have been drawn up on the basis of the experience of the starting up work at the AETs with the VVER-440 reactor. These take up the basic questions involving the structure, volume and content of the starting up specifications, the basic stages of the starting up work are outlined, the goals, initial state of equipment and systems are described and in addition the amount of basic work carried out in each stage is given. The recommendations provide a consolidated network schedule for the starting up work.

Of important significance is the subject "Elaboration of Recommendations on the Organization and Methods of Repairing Equipment at AETs with VVER-1000 Reactors." The recommendations examined the questions of repairs which are specific for the structures and designs of high-powered AETs with VVER-1000 reactors.

On the subject "The Development and Creation of a Decontamination System in the Radioactive Loop" a technical design has been worked out which includes the decontamination methods and decontaminating devices for surfaces in buildings and equipment, including for disassemblable equipment, the methods and calculation criteria for stationary decontaminating equipment of large structures, as well as the criteria for the technological and economic assessment of decontamination in the first loop and the devices for manufacturing and distributing the decontaminating solutions.

In addition to this, a study has been made on the basic proposals for construction and installation methods for building the AETs with the VVER-1000 reactors. The basic provisions give the basic solutions for the technology, mechanization and organization of construction-installation work for the VVER-1000 power units, including the organizing of the construction of the buildings, the installation of production equipment, the organizing of the construction site and so forth.

A large portion of these fundamental provisions have been tested out in building the fifth unit at the Novovoronezhskaya AETs. An engineering plan has been made for an integrated system of equipment to concrete the protective lining of the reactor section of the power unit with the VVER-1000 reactor. This system includes a mechanized sliding form, a set of equipment to deliver the concrete by a concrete pump and distribute the concrete mix around the periphery of the walls of the structure. The plan contains the basic calculations for the forms of original design, a proposal for the assembly and disassembly methods as well as the basic rules for carrying out the production work. Full mechanization of the concreting in building the protective linings in accord with the performed work provides a significant economic effect and reduces construction time for the protective lining. A modern method has also been worked out for a metal air-tight lining with the inspecting of the tightness of its seams in the process of its manufacture and use.

Of great importance were the development and creation of a system for special water treatment (SWT). Due to the dependable operation of the existing SWT systems for maintaining the given water-chemical conditions in the first and second loops and the ensuring of high corrosion resistance of the structural materials the formation of sediment on the surface of the fuel elements was excluded.

At present there is the urgent question of increasing the efficient operation of the SWT installations due to the higher demands made on the total amount of radioactive radiation from the AETs and the tolerable amount of radioactive contamination in the equipment of the first loop. In this regard, the section has worked out the plans for the SWT systems of the AETs and these consider the experience in the designing, starting up and operation of the SWT equipment at the existing AETs and information on the efficiency and possible methods of their improvement.

Along with the program for the accelerated designing and construction of the AETs with the 1,000-megawatt water moderated reactors, the section has given great attention to working out a common approach of the CEMA countries to solving the question of safety in operating the AETs, the problems of limiting environmental pollution in the generating of electric power from the AETs and the problems of raising their economicness, dependability and flexibility.

On the first of these problems, the sections have worked out "Rules and Methods for Nondestructive Inspection of the Basic Metal and Welds of Equipment in the First Loop of the AETs with VVER-440 Reactors During Starting Up and Operation." The inspection of the state of material in the equipment of the AETs is part of all the essential measures relating to inspection and supervision. It provides protection against radiation, nuclear safety and the readiness of the equipment. The document provides recommendations for the operating personnel of nuclear installations with VVER reactors for preparing and conducting inspections for the state of the material. This document contains the basic methods for inspecting equipment at the AETs as well as the requirements for the scope and dates for carrying it out.

The Section has also worked out other materials for similar purposes, including: "Specifications on Metal and Weld Quality for Equipment in the First Loop of the AETs" and this can be used in drawing up instructions and standards in the individual nations related to the questions of equipment quality in the AETs having VVER as well as for working out inspection programs prior to the completion and during the operation of the AETs as well as the "Basic Provisions on Organizing and Carrying Out Inspections of the Basic Metal and Welds During the Construction, Installation and Operation of the AETs."

The wide-scale development and the increase rate of nuclear power in the CEMA nations demand ever-greater attention to the problem of the impact of the AETs on the environment and the elaboration of measures to limit this.

In accord with the commission's plan, Section 5 has drawn up specific programs to carry out the subject the aim of which is to elaborate a fundamental safety document on "Basic Provisions to Ensure AETs Safety During Design, Construction and Operation." The extensive development of nuclear power and the growing share of the AETs in the total capacity of the power systems necessitate an evermore attentive attitude toward the economicness, dependability and flexibility of the AETs and their elements. The technical and economic indicators of the AETs depend substantially upon the requirements of the power system. Consequently, the questions of increasing the economicness, reliability and maneuverability of the AETs must be examined from the standpoint of these requirements. Uniform methods and criteria for a comparative assessment must be worked out for a specific study of the technical and economic indicators of the AETs and for elaborating the technical recommendations and decisions to improve these indicators. On a basis of uniform methods for calculating the technical and economic specifications it is possible to examine the economicness, reliability and flexibility of the AETs operating in the UPS as well as elaborate sound recommendations, requirements and technical solutions for improving them.

A thorough analysis of the experience of operating the AETs which are part of the UPS is also useful because this makes it possible to work out technical recommendations and standard documents for the design organizations and industry and these can be of help in developing the future types of AETs. In this regard the Section has worked out an appropriate program. The solution to these problems will make it possible to elaborate normative material on the requirements of the future AETs which will be built after 1980.

At present the attention of Section 5 is concentrated on solving the questions of the Long-Range Specific Cooperation Program (LSCP) to meet the needs of the CEMA nations for the basic types of energy, fuel and raw materials as applies to nuclear power.

One of the basic areas for scientific and technical cooperation in the LSCP is the already-mentioned problem "Developing Power Units with Water-Moderated Reactors with a Capacity of 1,000 Megawatts." In this area, Section 5 has already carried out a number of projects including: "The Elaboration of Environmental Protective Measures in Generating Electric Power at AETs," "The Elaboration of Technologies for Creating Devices and Equipment for Remote Inspection and Control of the State of Metal and Welds in Equipment of the First Loop in the Operating Process" and others. Within the Section work has been commenced in the CEMA countries of studying sources of centralized heat supply based on nuclear fuel.

Cooperation within the LSCP for developing the VVER-1000 power units will be carried out in the following basic areas:

1) The improving of the physical and thermophysical characteristics of the reactor installation and the establishing of its safety;

2) Optimization of design solutions for power units and the elaboration of an optimum method for building the AETs;

3) The creation and testing of experimental models for individual types of AETs equipment.

At present, the carrying out of this program is moving into the area of actual implementation.

Even in preparing the agreement, the member countries along with the CEMA Secretariat and Interatomenergo decided that the preparatory phase of collaboration on each subject would encompass, as a rule, four stages which had already been tested out in organizing work on a multilateral basis. These are:

1) The elaboration of the technical requirements (questionnaire) by the coordinator of the subject and which would briefly define the tasks of development;

2) The determining of the participating nations on the basis of the technical requirements for the scope and form of their participation in working out the given subject;

3) The elaboration by the coordinator of a working program and calendar plan for carrying out the subject considering the specific contribution of the participating nations to the development;

4) The coordinating of the work program and calendar plan by the countries participating in the development (as a rule at a meeting of specialists from these countries).

At present for the basic part of the subjects in the programs relating to Section 5 for the AETs the technical requirements have been met and proposals are being prepared by the countries on the scope and form of their participation in working out these subjects. For two of the subjects in the program, the four stages of the preparatory phase have been carried out and actual work is starting under the calendar plan.

Thus, the first practical steps have been made to carry out the cooperation agreement to develop atomic power units with VVER-1000 reactors. A sound basis has been established also for commencing work on other subjects and for successfully completing the entire program.

10272
CSO: 2200/112

DEVELOPMENT OF POWER ENGINEERING INFORMATION SYSTEM VIEWED

Sofia ENERGETIKA in Bulgarian No 5, 1981 pp 70-72

[Article by Mikhail P. Yaganov, coworker of the CEMA Secretariat and chairman of the MOSNTI of the Permanent CEMA Commission for Cooperation in the Power Engineering Area: "The Role of the MOSNTI in Developing the Power Industry of the CEMA Countries"]

[Text] One of the tasks of the comprehensive program to further deepen and improve cooperation and development of socialist economic integration among the CEMA countries has been the founding of an international scientific and technical information system (MSNTI). This year marks the 10th anniversary of its activities.

To carry out this task the Permanent CEMA Commission for Power Engineering [PCCPEA] at its 38th Session (1973) adopted the basic provisions of an international sectorial system of scientific and technical information [MOSNTI] in the area of power engineering. Here the following goals were set:

1) To inform the nations participating in the system of all scientific and technical information contained in publications on the questions of power engineering;

2) To avoid (to reduce as much as possible) unjustified duplication in processing the information;

3) To set up, in utilizing the advantages of the international division of labor, an effective information reference service for the various levels of management and production in the CEMA countries.

It must be emphasized that the PCCPEA is one of the first sectorial systems which has begun to carry out the designated aims.

At the end of 1973, the PCCPEA set up a body for coordinating and carrying out the tasks and this was the Council of the International Sectorial System for Scientific and Technical Information (MOSNTI) in the power engineering area with representative leaders from the national sectorial centers and approved the main areas of its activities.

It was essential to solve a number of organizational questions such as:

1) An analysis of the sectorial scientific and technical information bodies existing in the countries in order to determine the level and their technical capacilities;

2) Determining the types of informational publications which the system would provide for the countries;

3) The establishing of a unified procedural approach to making up the information reference holdings.

This was a formative period for the basic principles of information work under the direct control of the Permanent Commission.

In 1977, the system's council submitted to the PCCPEA a report for 1973-1976 which pointed out that the carrying out of the organizational and technical decisions during this period had contributed to the creation of the MOSNTI which was functioning on the basis of the traditional forms of information work and information reference services.

At that time a regular exchange of publications was organized by the national sectorial centers and systems for information reference services were set up on a request-and-answer basis as well as selective information dissemination (SID) which began operating in accord with the range of activities of the PCCPEA. The work was organized in such a manner that upon the request of each nation, the working bodies of the system sent out copies of documents or information on questions kept in the information reference holdings.

The selective dissemination of information was carried out by providing the subscribers with a subject choice of bibliographic cards with annotations or abstracts and a copy of the documents. Thus, it was possible for all the MOSNTI member nations to gain direct access to the national information reference holdings which were accumulating the scientific and technical progress in the sector.

A positive factor was the joining of Cuba and Mongolia with the countries which were relatively advanced in information terms such as Bulgaria, Hungary, the GDR, Poland, Romania, the USSR and Czechoslovakia. This provided them with an opportunity to make fuller use of the reciprocal scientific and technical potential of our nations in the power engineering area.

The system's council each year analyzed the forms of information reference services and made the necessary changes, bearing in mind the interest of the countries. In 1979, certain changes were made in the SID and request-and-answer systems and as a result of this the requests began to be more specifically formulated and there was a rise in the interchange of scientific and technical documents. While in 1976, 42 requests were drawn up for the SID system, in 1979, the number was 74. In 1976, for the request-and-answer system, the nations received 58 titles of copies of primary sources, and in 1979, 124 titles. Over the 1976-1979 period, the number of exchanged publication copies by the information centers of the MOSNTI member nations had risen from 850 to 1,784. The time for carrying out the requests was reduced from 10 weeks in 1976 to 8 in 1979. The interchange of the national lists of classification headings carried out within the system upon the proposal of the council provided high accuracy in formulating the requests. We must note the great activity of the electric power scientific and technical information bodies of the GDR, Hungary and Bulgaria in realizing these indicators.

Along with information reference services for subscribers, the system's council is active in providing information to the PCCPEA. The first steps in this area were the terminology studies and this halted the activities of the temporary work group under the Permanent Commission.

All the members of the system's council participated in creating the film "The Fires of Friendship" which was highly praised at the jubilee CEMA Session in 1979 in Warsaw. The council has also prepared the exhibit "Twenty Years of PCCPEA Activities."

The 51st Session of the PCCPEA instructed the council to improve informational support for developments related to carrying out the tasks deriving from the Long-Range Special Cooperation Program in the Area of Power Engineering (LSCP). In line with this, under the MOSNTI for power engineering the following reviews were prepared and published on the subjects of the LSCP:

1) The use of nuclear fuel sources for central heating (coordinator--Bulgaria);

2) The development of new high-powered energy units for TETs (coordinator--Poland);

3) Highly-flexible high-power energy installations operating on solid fuel and used to cover peak and semipeak loads (coordinator--Hungary).

The publishing of reviews on the LSCP subjects will be continued in the future. At the moment we are preparing for publishing reviews on the rational use and saving of fuel and energy resources in electric power production (coordinator--USSR) and the state and prospects for the development of hydropower in the CEMA countries (coordinator--the CSSR).

The PCCPEA has assigned the study to the International Sectorial Automated System of Scientific and Technical Information (MOASNTI).

A basic aspect in carrying out this task is the creation of an information-retrieving language which would include a polyglot information retrieving dictionary and a polyglot classification of subject headings. The normative and technical documents of the MTsNTI [International Center for Scientific and Technical Information] as well as the procedure and instructions for compiling the polyglot dictionary approved by the MOSNTI have served as the guiding materials in the study. The creation of a polyglot dictionary has been carried out by dividing up the labor and distributing the subject headings of the systematized indicator of the dictionary among the MOSNTI member nations.

In 1977-1980, the parts of the polyglot thesarus were worked out as follows: In 1977, Electric Power Engineering (with the GDR as the nation in charge); in 1977-1978, Thermal Power Engineering (Poland as the nation in charge); in 1978-1979, Hydropower Engineering (Bulgaria as the nation in charge); Nuclear Power (the USSR as the nation in charge); Solar Power, Geothermal Power and Wind Power (Hungary as the nation in charge) and Protection of the Environment (the CSSR as the nation in charge). The subject heading of Power Construction is being worked out. The plans for the individual parts were discussed and approved by meetings of specialists after which these were approved by the Council of the MOSNTI for Power Engineering.

The elaborated parts represent a set of systematized and alphabetized lexicosemantic indices and descriptions in six languages (Bulgarian, Hungarian, German, Polish, Czech and Russian). Only the subject heading Hydropower Engineering has been published in Romanian.

The elaboration of a polyglot classifier of subject headings began in 1978 and is based on the 2-3-tier classification of subject headings used by the MTsNTI. A draft for the third level of the subject heading Power Engineering has been compiled and the fourth level of the classification is in the process of being worked out.

As part of the bilateral cooperation between the USSR and GDR, an experimental test was run on the technical solution and possibilities of the exchange of information on magnetic tape between the national automated scientific and technical information systems. For carrying out the experiment, a mixed file was prepared containing descriptions of 200 documents for which 20 requests were sent and processed. The experiment showed that it was possible to exchange magnetic tape information using the international communications format for data recording MEKOF-2 which overcomes the differences in the hardware and software of the national ASNTI [automated system of scientific and technical information]. However, during the experiment differences were discovered in the information, functional-organizational and particularly the linguistic support of the national ASNTI and the overcoming of these is complicated and necessitates further joint work.

The MOSNTI member nations have begun to set up a MOASNTI on the basis of the positive experience from the functioning of the MOSNTI in its traditional forms, using the main principles for carrying it out (cooperation and the mutually advantageous division of labor) as well as with modern equipment with the prospects of cooperation among the national information systems as part of the MTsNTI.

The creation of the MOASNTI for electric power is regulated by the documents of the council, the Committee of Representatives of the nations and the PCCPEA and is carried out by all the participating countries in accord with the coordination plans for its elaboration and introduction.

In utilizing the experience of setting up the national systems, the following stages were adopted for working out the plans: Technical specifications, technical design and working design for the project.

The technical specifications were worked out within the MOASNTI and approved by the PCCPEA at its 53d Session in 1978. It defines the basic principles for setting up the system, the tasks and demands on the basic technological processes and range of equipment.

The technical design of the system made in accord with the requirements of the Composition and Content of the Technical Design (approved by the Committee of Representatives) contains the basic design solutions both for the system and for the individual tasks. It establishes the stage-by-stage completion of the system.

The design envisages the elaboration and introduction of the primary tasks (the feeding in and storage of the information, information reference services under the condition of the selective distribution of the information and retrospective retrieval, as well as editing and publishing work) and its use during the first stage of introducing the applied programs pack (APP) of the ASPID [?automated system for the publishing of documents] in the main body of the system with the possibility of further utilizing a more advanced APP standard for all or a majority of the member nations of the MOASNTI for Electric Power (in particular, the use of the APP of the AIDOS [expansion unknown] in the second stage). The technical design of the system after approval by the MOSNTI Council was approved by the PCCPEA at its 54th Session in May 1979.

At present the working designing is being completed. This is being done by all the MOASNTI member nations considering the possibilities and interest of them in the principle of the international division of labor. The working plan must contain a set of instructional and procedural materials which would control the system's functioning and determine the procedure and rules for carrying out all the technological processes.

The working design envisages the creation of a unified data base for the system with organized information reference services for all the subscribers and providing the various types of traditional information services. The acquiring of the information base will be done both by descriptions of departmental materials from all the participating countries as well as by descriptions of documents relating to the field and received from the magnetic tapes of the external data sources such as the international specialized and sectorial ASNTI which are part of the CEMA MSNTI. The MTsNTI and the main body of the MOSNTI, the USSR Informenergo [Power Engineering Information System] have concluded an agreement to carry out joint work on cooperating with the International Specialized Information System for Scientific Research (MSIS NIR). Even in the first stage of introducing the system there are plans to exchange information in the international communicative format for magnetic tape recording considering the readiness of the individual nations to organize such exchange.

At the end of 1979, the first edition of the working plan of the system was prepared. The linking up of the national sectorial automated systems for scientific and technical information into a unified international automated system has created definite difficulties during the designing period and these will also be encountered during its introduction into experimental use.

Bearing in mind that the question of a rational division of labor is one of the bases for the efficient functioning of the system and for introducing order into the making up of the information reference holdings of the countries, the system's council is working actively to organize the cooperation of the MOASNTI for Power Engineering with the other sectorial and specialized systems of the CEMA MSNTI. As a start, informational materials relating to the sector must be obtained from the

International Information System for the Publishing of Documents the main body of which is the VNINITI [All-Union Scientific Research Institute for Scientific and Technical Information]. We have already begun to make experimental use of the magnetic-tape information from this system. There are plans to set up links with the other specialized systems of the MTsNTI and this will provide an opportunity to incorporate documents from the entire world into the CEMA power engineering information system.

In the past years enormous work has been done, but still there are many unresolved questions along the path to international cooperation in the area of power engineering scientific and technical information.

Under the conditions of the scientific and technical revolution which has brought about a significant acceleration in the pace of scientific and technical progress, it is essential to improve the MOSNTI for Power Engineering for more effectively utilizing the world achievements of science and technology to improve the management of the power industry in the CEMA nations.

10272
CSO: 2200/112

END

END OF FICHE

DATE FILMED

26 OCT 1981